

**NEONATAL NIGHTINGALES: LIVE PARENTAL AND
NEONATAL NURSE INFANT-DIRECTED SINGING AS A
BENEFICIAL INTERVENTION FOR THE HEALTH AND
DEVELOPMENT OF INFANTS IN NEONATAL CARE**

BY

R. BARNELL

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**University of Wolverhampton
School of Sport, Performing Arts and Leisure
Department of Music**

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ABSTRACT

It is the aim of this study to establish live neonatal nurse and parental infant-directed singing as a potentially efficacious intervention that is beneficial to the health and development of infants in neonatal care and which could conceivably be integrated into nursing practice and the neonatal care environment in a way that is both practical and viable. An appraisal of extant literature highlights the need for further intervention in neonatal care, explains how music meets the necessary criterion as appropriate intervention and discusses its potential, specifically infant-directed singing, to be provided by neonatal nurses and parents. The willingness of neonatal nurses and parents to engage in infant-directed singing in the neonatal care unit environment is assessed through an informal questionnaire survey. From the findings of this and other studies, implications and recommendations for both areas and methods for future research are extrapolated.

The intention behind this study is to generate interest and awareness of academics and medical professionals in this potentially cost effective intervention, promoting future research and practice. It is hoped that this will ultimately result in the comfort of song providing profound benefits to the physiological, psychological and emotional development and wellbeing of all infants in neonatal care.

ACKNOWLEDGEMENTS

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LIST OF ACRONYMS

BAPM: British Association of Perinatal Medicine

HES: Hospital Episode Statistics

IDS: infant-directed speech

KC: kangaroo care

MT: music therapy

NHS: National Health Service

NICU: neonatal intensive care unit

NIDCAP: Neonatal Individualized Developmental Care Assessment Programme

ONS: Office for National Statistics

PAL: Pacifier Activated Lullaby device

INTRODUCTION

Imagine the existence of a drug for premature and sick infants capable of increasing weight gain, raising oxygen saturation levels, facilitating neurological development, reducing pain, decreasing the number of days to discharge, lowering heart rate, reducing episodes of apnoea and bradycardia and promoting parental bonding and language development. Further imagine that this drug is readily available, relatively inexpensive and yet unused in medical practice. Such a medical phenomenon does exist, offering all these benefits and more, not in the form of a drug, but an intervention: that of music.

Music as a healing art has ancient cross-cultural roots, having been practised in various forms throughout history, and is currently being rediscovered by modern science. Music intervention can take many forms, several of which are referred to within this study; however, it is the purpose of this study to establish the potential for one specific form of intervention, that of live neonatal nurse and parental infant-directed singing, to provide benefits to the health and development of infants in neonatal care in a practical and viable way that can be integrated into standard nursing and parental practice in the neonatal ward setting. Forming a basis to this proposal is the hypothesis that live infant-directed singing is a beneficial intervention for infants in neonatal care that requires no specialist musical training to perform, and that its delivery by nurses, who are always present and trained in infant responses, and parents, who are sometimes present and can bond more effectively with their infant as a result, is an efficacious alternative to the introduction of additional professionals into the ward for its delivery.

In order to verify this hypothesis and establish the practicality and viability of the proposed intervention, it is first necessary to assess the need for further intervention through appraisal of the current state of neonatal care, both in the UK and worldwide,

and also the many and varied challenges that face infants who require that care. The UK is the immediate focus for instigation of the proposed practice; however, the UK cannot be considered in isolation of the world view as infant hospitalisation is an increasing global issue and advancements in neonatal care are relevant worldwide.

Just as UK neonatal care must be viewed in a global context, so too must research into the field of music intervention in neonatal care as many countries worldwide have contributed to its advancement. This inclusive research must be consulted in order to ascertain whether music can meet the need for further intervention, with specific reference to infant-directed singing.

Subsequently, the potential efficacy of nursing practice as a means for the delivery of music intervention needs to be determined through investigation into the ability of nurses to provide music intervention and how it can be integrated into nursing practice. This can be achieved through a study of literature pertaining to the use of music intervention in medical settings, identification of the training necessary for delivering both music intervention and monitoring its provision, and the investigation of the neonatal nursing role and responsibilities.

Parental and nurse comfort with infant-directed singing in the neonatal care ward context is vital to operationalising future research and ultimately the proposed intervention. To gauge an indication of the willingness of parents and nurses to engage in infant-directed singing in this context, the findings from an informal questionnaire survey will be analysed, from which a sense for the potential and viability of future research and the proposed intervention may be ascertained.

Of the vast catalogue of extant research into the field of music intervention with infants in neonatal care, few studies are regarded as scientifically sound. So as not to repeat the mistakes of the past, it is necessary to draw from the experiences of others by identifying practical and theoretical errors and also relevant areas of study so far insufficiently researched. The resultant information will provide a basis for future research with a view to the establishment of neonatal nurse and parental infant-directed singing into neonatal practice.

Music intervention is generally considered to be the act of purely listening to recorded music prescribed by the medical practitioner, which is universal in its treatment of specific conditions, whereas music therapy is the responsive, individualised use of music based on therapeutic processes by a trained music therapist (Bradt *et al*, 2011, p.2). For nurses and parents to engage in live infant-directed singing in the neonatal care context, they must go beyond the bounds of music intervention and adopt something of the role of the therapist in order to engage in infant-directed singing responsively, which is essential in order to avoid infant overstimulation. Because the act of infant-directed singing in this context would blur the boundaries of the accepted definitions, for the purpose of this study the term ‘music intervention’ applies to all music, be it live or recorded, which is used in healing contexts. The term ‘music therapy’ indicates music intervention which is provided by a trained music therapist.

It has been necessary to implement several changes to this study between the planning stage of the written proposal and its final execution. The most significant change has been the omission of practical research, which was deemed untenable given the inhibitive nature of the National Health Service (NHS) research policy and personal time restrictions. In place of the practical research an informal questionnaire survey has

been conducted to gain a sense of the willingness of neonatal nurses and parents to sing in the neonatal ward environment.

Through the process of researching relevant literature it gradually became apparent that neonatal care is regarded in a global context and that advancements in the field are of global concern, necessitating the modification of the study's isolated UK focus. It also became clear that parental infant-directed singing has unique implications for bonding and infant development, and must be included in the proposed intervention where possible. The title has been altered in accordance with these changes and now also reflects consideration of the justification for the proposed intervention and its purpose, rather than merely the potential for its integration into neonatal care.

NEONATAL CARE

Infants in neonatal care

There are currently 222 neonatal units in the UK which provide differing levels of essential care to nearly eighty thousand infants born each year (Roberts, 2010; Bliss, 2011a). These units are divided into three types, which provide three graded levels of care (see Appendix A, Tables A1 and A2) and should not exceed 80% occupancy, a capacity which is being overstretched according to the *Bliss Baby Report 2010*, with some units exceeding 200% occupancy for extended periods and neonatal intensive care units operating at an average 94% occupancy (Kirrane, 2010, p.4).

The minimum standards for care are established by the British Association of Perinatal Medicine (BAPM) which specifies the number of nurses required for each infant at each level of care, standards which have not been met in recent years due to nursing shortages (Roberts, 2010). 1,150 more nurses were needed in order for more than 75% of neonatal intensive care units in England to meet minimum nursing standards in 2010, with nearly 80% of these nursing posts being unfunded (Kirrane, 2010, p.4). The staffing forecast for neonatal units has not improved, with further NHS cutbacks resulting in the loss of a further 140 posts in 2011 (Campbell and Meikle, 2011).

Premature birth, ‘one of the most significant problems in perinatology’ (Beck *et al*, 2009), accounts for more than half of the infants in need of neonatal care and approximately 8% of the total number of live births in England every year (HES, 2009, p. 13). Media reports indicate that the number of premature births has seen a recent

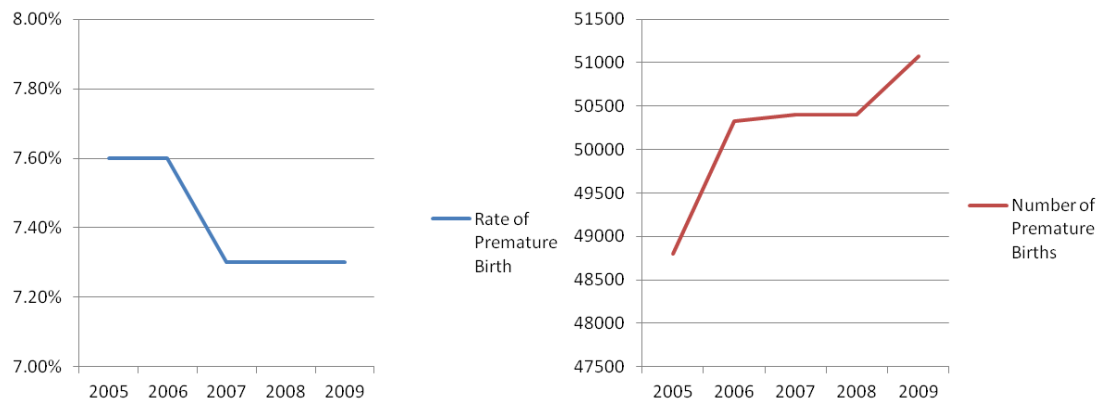
increase, peaking at 8.6% in 2006-2007, a figure which had remained static at approximately 7% for the previous fifteen years (BBC News, 2008).

A long-term increase in the number of low birth weight births was also reported for 2006, with figures rising to 7.8% from 6.7% in 1989. According to one report, these increases are due to changes in medical practice and social factors such as the age and weight of mothers (Lister, 2009). Increasing survival rates for premature birth may also account for this increase (Tommy's, 2004, p.5), which presents a growing problem for the NHS as life for both premature and low birth weight infants holds many challenges, both immediate and often ongoing (Bamfield, 2007).

However, these statistics could be misleading. The NHS has reported changes in their methods of data gathering which, they speculate, may be responsible for the increase in premature birth figures (BBC News, 2008). In addition, the Office for National Statistics (ONS) has only been able to collect statistical data on gestational age in England since 2005 due to incomplete Hospital Episode Statistics (HES), which means that it is impossible to derive any long-term changes in levels and trends of premature birth from this source either; however, the statistical data for the period 2005-2009 shows that, although the rate of premature birth has marginally decreased, the number of premature births has significantly increased (see Figure 1).

Figure 1¹

Trends in rate of premature birth and number of premature births (ONS, 2011, 2010, 2009, 2007)



These recent trends cannot be regarded as unequivocal because they evidence discrepancies in data collection between the ONS and the NHS, as the latter reported figures for the rate of premature birth in 2006-7 of 8% (HES, 2008) which, as previously stated, were reported as 8.6% by the media (BBC News, 2008). Despite these inconsistencies, data from neither source contests that the number of premature births has increased.²

Unlike England, Scotland has complete records of gestational age data (Moser and Hilder, 2008), which has formed the basis for research at Edinburgh University. The research findings indicate an increase in the number of premature infants born between 1980-2004 from 5.4% to 6.3%, and a 50% decrease in the risk of neonatal death from premature birth which, according to American research, increases the risk of abnormalities (Standley, 1991, p.1). These results indicate a higher number of

¹ The data provided by the ONS for 2007 and 2008 is only available combined, so the mean figures (7.3%; 50,399 births) have been used for both years.

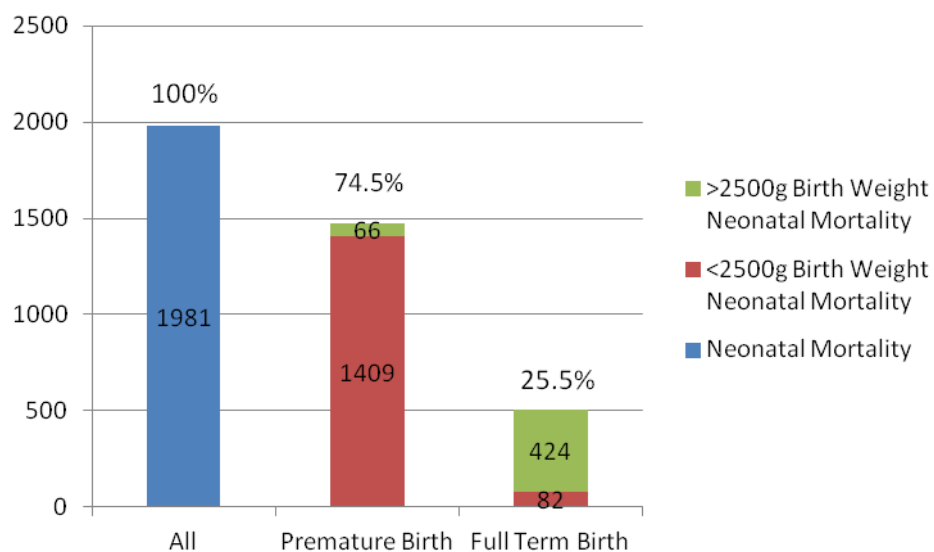
² HES data only available from 2006 to 2008.

premature infants requiring neonatal care and that could be suggestive of a rise in figures for the UK as a whole (Norman, Morris and Chalmers, 2009).

Low birth weight and premature birth states are not synonymous, as not all premature babies are born with low birth weight and not all low birth weight babies are born prematurely. According to the most recent statistics published by the ONS (2011) for the year 2009, approximately 2.9% of full-term births (18,847 infants) and 61.3% of premature births (31,305 infants) were low birth weight. The neonatal mortality rate (death within the first twenty-eight days of life) for the latter represents the largest group of the various denominations by gestational age and birth weight (see Figure 2).

Figure 2³

Infant mortality rates by gestational age and birth weight 2009 (ONS, 2011)



This statistical data demonstrates that infant mortality rates for premature infants accounted for the majority of neonatal deaths, 74.5%, and that low birth weight is a more highly prevalent factor in premature birth neonatal mortality than in full-term birth

³ These figures only include those with known gestational age and birthweight.

neonatal mortality. These figures indicate that premature, low birth weight infants are the highest risk group and that further measures need to be taken to support them. In practice, it is generally accepted that this is the group referred to by the terms 'low birth weight' and 'premature' due to the majority of low birth weight infants being premature and *vice versa* (Lantos and Meadow, 2006, p.13).

None of the currently available statistical information detracts from the fact that there are thousands of premature babies born each year in the UK that are in need of neonatal care. Indeed, prematurity presents a global dilemma, as the average global figure exceeds that of the UK, standing at an estimated 9.6% in 2005 (12.9 million births) (Beck *et al*, 2009), calling for further advancements in the care of these infants to further decrease the risk of death and abnormalities.

However, prematurity is only one of three predominant categories of infant requiring neonatal care: those born at varying degrees of prematurity, those who are born full or near term suffering from acute illness and those who are born with congenital abnormalities (Lantos and Meadow, 2006, p.14). There are generic, observable differences in the provision of medical treatment and prognosis for these three groups. The condition of infants suffering from acute illness will generally improve or decline rapidly, resulting in recovery or death, although complications may occur that impact upon quality of life as a result of the illness, such as neurological impairment. Treatment for congenital abnormalities comprises life-sustaining interventions and/or corrective surgery. Treatment and prognoses for premature infants are less clear-cut, as 'prematurity is both an acute crisis and a chronic condition' (Lantos and Meadow, 2006, p.15). The outcome of treatment for the premature infant cannot generally be defined as simply as success or failure: death may be rapid or

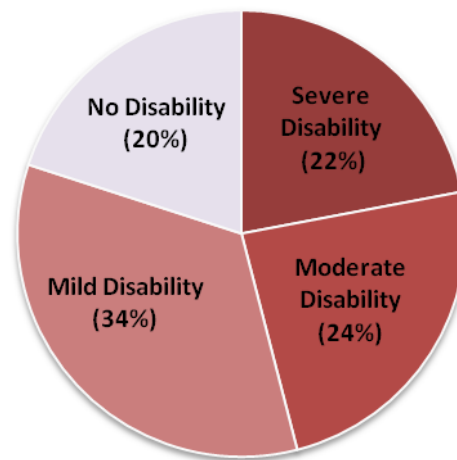
delayed; life may be inhibited by a range of physical and neurodevelopmental abnormalities, or none at all.

At its most critical, care for premature and high risk infants requires the administration of essential interventions necessary for survival, the nursing priority being to support cardiac and respiratory systems as needed, regulating body temperature and feeding (Nurse, 2009, p. 487). In addition to this, parent-infant bonding is encouraged and developmental care, a recent innovative addition to neonatal care practised in some UK neonatal units, provides individualised care that promotes physical and environmental stress reduction for infants in order to allow the development of physical and neurological systems (Nurse, 2009, p. 473-489).

Physical and neurological underdevelopment at birth can result in many complications which, even if survived, can have long-term, often disabling consequences. Severe impairment is most likely to occur in ‘extremely premature’ infants (see Appendix B), and although the mortality rate for this group has decreased over time, the incidence of neurodisability has not (Colvin, McGuire and Fowlie, 2004, p.1390). An ongoing UK study conducted by EPICure which began in 1995 revealed that 22% of the ‘extremely premature’ infants in the study group went on to suffer with severe disability by the age of six, with only 20% having no problems at all (Tommy’s, 2010) (see Figure 3).

Figure 3

Incidence of disability in an ‘extremely premature’ study group (Tommy’s, 2010)



Research based upon these findings estimates the financial burden of premature birth in England and Wales on the NHS as ‘almost £1 billion a year more than if they were born full-term’ for the first eighteen years of life (Lister, 2009; Mangham *et al*, 2009).

Global statistics show that, while prematurity and morbidity cannot be seen to have increased due to lack of comparative data, research indicates a high current level which is expected to rise due to increased survival rates resulting from improving medical technologies in developing countries (Beck *et al*, 2009).

Challenges for the infant in neonatal care

Every infant in neonatal care faces a multitude of challenges, challenges that may not only involve physical, neurological and emotional development but frequently the fundament of survival. The premature infant is presented with a recognised set of challenges, as his or her underdeveloped body struggles to adapt to life *ex utero*. These challenges include: breathing difficulties, resulting in blood oxygen saturation levels lower than those necessary to the development of bodily systems (hypoxia) such as the central nervous system; a decreased ability to initiate and co-ordinate sucking and

swallowing reflexes, often resulting in the need for feeding intervention in the form of nasogastric tubes; and the ability to regulate body temperature (Courtnage, 2001, p.6).

The severity of these problems is dependent upon the stage of prematurity (see Appendix B) and the existence of other complications.

In addition to hypoxia, intraventricular haemorrhages and respiratory distress syndrome are further medical complications commonly associated with prematurity which can negatively impact upon the central nervous system. These premature risk factors and the premature change of the foetal environment have been shown to inhibit proper brain development and contribute to the causal factors of cognitive deficits later in life for the premature infant (Curtis *et al*, 2002, pp. 1646-56; Neal and Lindeke, 2008, p.321).

Problems involving oxygenation, ventilation, nutrition and fluid balance and thermoregulation are not unique to the premature condition, and primary nursing goals seek to provide balance in each of these areas for all infants in neonatal care (Nurse, 2009, p.473). Many infants will also experience pain or distress as a result of surgery or painful procedures, the latter being a common factor in day-to-day neonatal intensive care. An American research study has highlighted the need for improvements in the provision of pain relief for infants in this setting, as 40% of the infants included in the study received no analgesics during their stay and experienced anything up to fifty-three potentially painful procedures per day (McClain and Kain, 2005, pp.1073-4). However, research evidence cited by Professor Jayne Standley (2011, p.10) indicates ‘that the use of analgesics in the vulnerable infant early in life heightens pain perception until 8 to 10 years’, suggesting that an alternative form of pain relief is needed in the provision of neonatal care.

Stimulation

The womb environment provides the foetus with continuous stimulation in several forms. Tactile self-stimulation is experienced through changes in touch, temperature and pressure resulting from foetal movement which, in conjunction with maternal movement, also provides vestibular stimulation from resultant fluid movement and oscillation. Gustatory-olfactory stimulation occurs when amniotic fluid passes regularly through the nose and mouth and visual stimulation occasionally occurs when light penetrates the womb environment. During the third trimester auditory stimulation is experienced in the form of sounds both internal and external to the mother's body. Although the forms that stimulation takes following birth differ dramatically from those of the womb, the senses stimulated remain the same (Bremner and Fogel, 2001, p.512; Neal, 2008, pp.17-18).

A common challenge for the hospitalised infant is the effective self-regulation of arousal states, also known as behavioural states. An infant's inability to self-regulate arousal states can have a detrimental impact upon vital physiological functions which are of particular significance for the premature infant: blood oxygenation saturation levels, respiratory rates and, subsequently, growth and development. Self-regulation of behavioural states is necessary in order to achieve homeostasis (behavioural and physiological equilibrium), a process which forms one of June Kaminski and W. Hall's (*in* Courtnage, 2001, pp.7-8) three primary goals for neonates, the second being to '...process, store, and organize multiple stimuli. The third is that they must establish a reciprocal relationship with a primary caregiver and their environment'.

Each infant in neonatal care requires continued monitoring of arousal levels, measured in accordance with six specific sleep-activity states (see Appendix C) (Nurse,

2009, p.456). While control of stimuli is essential for infant neurological and physical development, as overstimulation can be detrimental to these processes, it is also necessary to provide appropriate stimulation to support them. This varies on an individual basis and also according to the infant's age and condition, for example: infants exposed to toxic substances require initial pacification to maintain homeostasis in order to rapidly develop the neurological system, followed by controlled stimulation. Premature infants require carefully monitored stimulation as they are more sensitive to it (Standley, 1991, pp.19-20).

According to Standley's (1991, pp. 20-1) 'General Principles of Infant Stimulation' (see Appendix D) stimulation is most appropriate when 'the infant is in a stable state of quiet alertness'. She also observes that stimulation can act as pacification if continuous and unchanging, the onset and discontinuation of which is arousing, and that the greater number of modalities employed increases this pacification. Stimulating modalities include: 'sound, light, movement, swaddling and temperature'. Of these stimulating modalities, music is both the most effective at decreasing infant activity response compared to other auditory stimuli and is also the most reliable.

Diana Neal and Linda Lindeke (2008) have derived a collective of 'key indicators of appropriate stimulation [for] ...desirable physiologic functioning in preterm infants' from various research studies, including several conducted by Standley. These key indicators are identified as:

...increased weight gain; higher oxygen saturation; lower than standard ranges of systolic blood pressure, heart rate, and respiratory rate; fewer apneic and bradycardiac episodes; using standardised behavioural observation scales for analysis of symptoms of pain in infants; and feeding progression indicated by increased calorie consumption and formula intake (Neal and Lindeke, 2008, p.321).

Environmental impact

The hospital ward is, in many respects, a hostile environment for the newborn in need of neonatal care: bright lights, physical isolation and over-stimulating handling and procedures which can be painful, contrast starkly with the protective intrauterine environment. Naturally, medical responses prioritize the physical stability of the infant, but these interventions frequently come at a price, often inhibiting the infant's natural development in other areas, development which has often already been disrupted by the cause of an infant's institutionalisation.

Environmental noise within neonatal care units, which research has demonstrated usually exceeds recommended sound levels in the USA, interferes with sleep, causes physiological stress and 'would be overwhelming even for healthy adults' (Gardner and Goldstone *in* Neal, 2008, p.19). Such research has yet to be conducted within UK neonatal units; however, it is to be expected that resultant findings would be similar within these comparable working environments. Several research studies cited by Neal and Lindeke (2008) also suggest additional detrimental impacts, caused by environmental noise, including:

...sensorineural damage to developing auditory structures, contributing to later language or auditory processing disorders... stress...[which] may result in low oxygen saturation levels, increases in heart and respiratory rates, and alterations in glucose consumption and intestinal peristalsis...fatigue, hyperalerting responses, and reflexive startles as well as fussing and crying (Neal and Lindeke, 2008, p.321).

A further concern, raised by Stanley Graven (2000, p.S91), is that environmental noise interferes with the infants' ability to hear speech, inhibiting 'auditory learning [which] is important for language acquisition and social attachment processes'.

Physical interventions may also restrict interaction that is important to development, especially in premature infants. Incubators, nasogastric tubes and other vital components of physical care inhibit physical interaction between the mother and the infant, interrupting the continuum of the ‘reciprocal interaction and stimulation’ of the intrauterine environment (Courtnage, 2001, p.7).

Developmental care

In order to combat the detrimental effects of the hospital environment and promote physical and neurological development in infants, a medical initiative called developmental care is increasingly practised in UK neonatal units (Abbott and Israel, 2008). Developmental care aims to reduce the stress caused by environmental stimulation by reducing environmental noise, handling and lighting in order to bring the hospital environment closer to that of the womb. To this end, positioning is also employed, emulating the ‘foetal’ pose within soft ‘uterine wall’ boundaries, a practice which also engenders pain and stress reduction, comfort, sleep, and helps to prevent long-term developmental problems with gait, walking and sitting (Nurse, 2009, p.489). Physical care is scheduled as infrequently as possible to minimise stress, and techniques that encourage specific behaviours are employed to support neurobehavioral development, including: ‘non-nutritive sucking, opportunities for grasping, swaddling and general motor containment [and] kangaroo care’ (Sizun and Westrup, 2004, F384). The Neonatal Individualised Developmental Care Assessment Program (NIDCAP) integrates interventions such as these into an individualised, family centred care strategy for all infants in neonatal care. (Sizun and Westrup, 2004, F384; NIDCAP, 2008).

Necessary improvements to UK neonatal care are expounded by the NHS and Department of Health (2009) in the form of principles for best practice, published as

Toolkit for High Quality Neonatal Services and include developmental care as a marker of general good practice; however, the form this practice takes differs dramatically between institutions. These differing approaches are discussed within a review of UK developmental care over time by Karen Hamilton and Maggie Redshaw (2009).

Hamilton and Redshaw observe not only the need for consistency of approach but also a supportive framework for developmental care practice:

Despite a significant increase in developmental care skills and infrastructure, variable approaches persist, with limited improvements over time. These findings reflect a UK culture that is ambivalent towards developmental care...In response, the challenge in increasing the uptake of developmental care will be to address the culture of neonatal care, particularly in relation to perceived workload barriers and resistance to developmental care practices. The funded training and growth of developmental care teams, with designated staff, could assist in fostering a more supportive developmental care culture, with benefits for infants, parents and providers of neonatal care (Hamilton and Redshaw, 2009, pp.1738-42)

Such differing approaches are not confined to UK developmental care practice.

Hamilton and Redshaw draw comparison with research data from studies into inconsistencies in practice conducted in the USA, Italy, Spain and Israel. However, were consistency to prevail, there remains an 'imperative' need, as Neal (2008, p.4) asserts, for the advancement of further developmental care strategies such as music, in order to reduce the personal and financial burden to society caused by the 'increasing incidence of prematurity, [and] significant morbidity' observable within the USA and indeed, worldwide.

As the number of infants surviving premature birth increases, so too does the incidence of abnormality. In order to reduce the incidence of such disability, improve life chances and reduce costs it is vital that research into developmental care be conducted with a view to standardised incorporation into neonatal care practice, and

further strategies identified such as music which may further this reduction (Sizun and Westrup, 2004, p.1; Neal, 2008, p.4).

Relationships

Of all the people involved in the care of hospitalised infants, the parents are the most important (Merenstein and Gardner, 2006, p.870). Parent presence is fundamental to establishing relationships, a process which, according to Graven (2000), needs to be facilitated within care provision:

Hospitals should seek out policies and practices that support and facilitate family members' sustained presence in the NICU [neonatal intensive care unit] and their participation in the infants' care...Additionally, care practices in the NICU must be organised to permit ample opportunity for the preterm infant to hear and respond to the voices of the family members (Graven, 2000, p.S91).

Both American and British neonatal care are gradually addressing this issue by providing family-centred care based on ten fundamental principles that aim to involve parents in the care of their infant (see Appendix E) (Merenstein and Gardner, 2006, p.871).

Donald Winnicott (*in* O'Gorman, 2007, p.106) famously summarised the axial nature of relationships to an infant's survival: 'There is no such thing as a baby — meaning that if you set out to describe a baby, you will find you are describing a baby and someone. A baby cannot exist alone, but is essentially part of a relationship'. More specifically, an infant needs a primary attachment figure, usually the mother, who provides comfort, protection and interaction that is 'reciprocal, synchronous and coherent... [and] serves as a secure base from which the infant may explore himself and the relationships he has formed with those around him', acting as a continuation of the *in utero* mother-infant relationship (see *Sound, music and intrauterine development*,

p.21). Maternal care forms the pinnacle of a hierarchical system of relationships and also serves to aid infant physiological and emotional regulation (O’Gorman, 2007, p.101-7).

The period immediately following birth ‘may be important for initiating infant bonding to the mother’ according to evidence from research conducted by Anthony DeCasper and William Fifer (1980, p.1174). This conclusion is based on findings that infants who have received a maximum of twelve hours postnatal maternal contact show preference for the mother’s voice over a non-maternal voice. As infants are often denied early maternal contact in neonatal care there may be implications for mother-infant bonding in this setting.

Individual and family therapist Shannon O’Gorman (2007, p.100) posits that a minimum of three factors influence an infant’s ability to form secure attachments: the infant’s internal system, the parent–infant relationship and the infant’s relationship with the broader context. These factors are particularly pertinent to infants in neonatal care, as hospitalisation can constitute a barrier to the development of a primary attachment figure relationship, and traditional parenting roles must often be shared with those providing medical care.

Homeostatic control of an infant’s internal system is not only necessary for survival but also for the development of relationships, which can only form as a product of organised behaviour. As previously discussed, the ability to maintain homeostasis is often compromised in hospitalised infants; this can result in detrimental impact on the infant’s ability to form and maintain relationships. Similarly, the parent-infant relationship can suffer as a result of hospitalisation through both physical and emotional separation of parent and infant, which may in turn influence an infant’s ability to relate

to the broader context, as the environment and relationships with others are often initially experienced by the infant secondarily through their impact upon their primary attachment figure (O’Gorman, 2007, p.101).

In addition to impeding infants’ ability to form relationships, the physical and emotional separation of the parent and infant is just one of many challenges facing parents of hospitalised infants, who may also experience stress as a result of the impersonal nature of the ward environment, lack of privacy, shared care-giving roles and feelings of guilt, fear and helplessness. Such stresses can, if manageable, make attachments strong, but can conversely inhibit parents’ ability to provide effective parenting, ultimately impacting upon the infants’ relationships with both parents and their environment (O’Gorman, 2007, p.102).

All of O’Gorman’s (2007, p.101) highlighted potential impediments to the ability of both infant and parent to form attachments as a result of infant hospitalisation serve to reinforce ‘the need for family focused interventions within the acute medical setting’. Developing interventions such as comfort holding, the resting of hands upon an incubated baby, and kangaroo care (KC), skin to skin contact against the parent’s chest, have proved effective in facilitating parent-infant bonding. Kangaroo mother care, skin to skin contact against the mother’s chest for a period of several weeks until full gestational age, has been trialled as a survival intervention for low birth weight infants in poorer countries where neonatal intensive care is ‘rationed’. Findings demonstrate that it halves infant death rate when compared to infants in incubators (Boseley, 2012).

Practice in countries with advanced neonatal care limits the use of KC according to infants’ physical condition, which can even prevent such contact (Bliss, 2010, pp.1-2) and there remains a need for interventions which do not rely on physical contact.

SOUND AND MUSIC

Sound, music and intrauterine development

By twenty to twenty-four weeks gestational age the foetal auditory system is sufficiently developed to hear sounds from inside and outside the mother's body, which the foetus can respond to and process by twenty-six to twenty-eight weeks gestation. All sound that the hearing foetus is exposed to is filtered through body tissue and amniotic fluid, muffling sound and eradicating high frequencies. The mother's body produces cardiovascular, intestinal and placental sounds which resemble the rhythms, structures and patterns of music (Neal and Lindeke, 2008, pp.320-1). Infants associate this 'womb music' with comfort and security, and its loss constitutes one of the most stressful aspects of adaption to extrauterine life' (Collins and Kuck, 1991).

Within the womb, womb music not only facilitates neurological development but also the 'learning' of emotional responses to auditory stimuli. When an infant is born prematurely this learning continuum is broken and their development is subsequently modified, the extent to which is, as yet, unknown (Abrams and Gerhardt, 2000, p.S34); however, research conducted by Charlene Krueger (2010, p.14) 'suggests that there may be a relationship between the preterm's early altered sensory experiences while cared for in the NICU and developmental outcomes'.

During the third trimester the hearing foetus begins to associate auditory, tactile and kinaesthetic pattern signals created by the mother, such as heartbeat, footsteps and voice, with her emotional responses to them. This is achieved by means of biochemical signals which are transmitted from the mother to the foetus in the form of changes in umbilical blood hormone levels, informing the foetus of the mother's emotive reaction to the auditory stimuli. This hormone 'communication' is reciprocal, with the foetus

hormone release informing the mother of its nutrient needs, and forms the beginning of the mother-infant bond. Richard Parncutt (2009, p.188-90) speculates that, over time, the foetus is 'conditioned' to respond to repeatedly experienced auditory stimuli in anticipation of the mother's hormone release, in a similar manner to the dogs' anticipation of food upon the sound of footsteps in Ivan Pavlov's well-known paradigm, and identifies this process as, potentially, 'the first step toward the emergence of music'. This theory is supported by research which indicates that emotional perception from music has been observed in infants from five months of age (Nawrot, 2003, p.75).

Auditory stimuli also produce physiological and behavioural change responses in foetuses of thirty-four to forty weeks gestation. Findings from a study conducted by Robert Abrams and Kenneth Gerhardt (2000) into foetal responses to acoustic (airborne sound) and vibroacoustic (sound delivered through tactile vibration) stimulus, indicate changes in physiological variables associated with behaviour states, including decreased breathing and increased movement and heart rate. Abrams and Gerhardt (2000, p.S34) conclude that 'subtle influences of acoustic stimulation in human foetuses suggest a prenatal development of human behaviour'.

Music that is repeatedly experienced by the foetus during the third trimester is retained in the memory and recognised after birth for up to a year (BBC News, 2001). Such music can go on to form a part of the playful, interactive communication between adults and infants in the form of expressive vocalisations, touch and movement known as *Motherese* or infant-directed speech (IDS), which act as a continuum of the emotive conditioning that infants experience *in utero* (Parncutt, 2009, pp.188-91) and also facilitate the 'moulding [of]...infants' brains into the appropriate shape to become effective members of human communities' (Mithen, 2006, p.84). Infants in neonatal

care often lack the emotive ‘conditioning’ of the womb and/or sufficient adult interaction after birth due to factors such as premature birth and the detrimental impact of the neonatal care environment (see *Environmental impact*, p.15), a deficiency which must be addressed given the cardinal importance of emotions to thought and behaviour (Mithen, 2006, p.100) and the fundament of communication to infants’ physical growth, behaviour and intelligence (Swartz and Ritchie, 2007, p.4).

Sound, music and extrauterine development

The therapeutic benefits of music on the health and development of infants in neonatal care has been the subject of extensive international research for over twenty years with many compelling potential benefits documented, yet there is still no requirement for music intervention in current neonatal care practice in the UK (NHS and Department of Health, 2009). The USA is at the forefront of research into music intervention in neonatal care, yet even here, after twenty years of research and the publication of results which indicate ‘protocols [that] meet evidence-based standards for inclusion in NICU medical treatment’, music intervention is still not a requirement for standard practice (Standley, 2011, p.10). Doubts regarding the practice of music intervention are due to controversy surrounding the overstimulation for neonates and the lack of scientific rigor of much existing research, according to Neal and Lindeke (2008, p. 322).

The majority of music intervention research with infants has been conducted specifically within neonatal intensive care units and following hospitalisation, as these are the groups that music therapists work with most frequently. This has resulted in a deficit of research pertaining to how music can be used to promote developmental goals in the ‘intermediate’ stage of neonatal care (Standley, 1998, p.533).

From an objective, scientific viewpoint music and noise are differentiated by their patterning: music being patterned sound and noise non-patterned sound. Although infants experience polar responses to the two sound forms, there is currently no evidence to indicate that premature infants can differentiate between music and noise, which can negatively affect premature infants (Neal and Lindeke, 2008, p.319). Despite this, Standley (2011, p.10) advocates the use of music to mask environmental noise.

The lack of evidence differentiating music from noise has led experts to express concerns over the potential for music to over-stimulate infants in neonatal care, claiming that music contributes to environmental noise levels. Nevertheless, through a catalogue of extensive research, music has proved effective in providing appropriate stimulation necessary to infant neurological and physical development. However, many research studies have also resulted in inconclusive and negative findings, which need to be resolved through further research before music can be accepted as a beneficial intervention in neonatal practice (Neal and Lindeke, 2008, p.322).

The physical benefits of music intervention

Music is used as an effective intervention with adults in clinical settings by harnessing the body's physiological synchronous responses to musical stimuli, a process known as entrainment. The role of music entrainment in medical settings is summarised by Deforia Lane:

Music is clinically recognised to influence biological responses such as heart rate, blood pressure, respiration rate, cardiac output, muscle tone, papillary responses, skin responses, the immune system and endorphin production. Music can entrain the body to calm or to accelerate depending on what type of music is used (*in* Brandes, 2009, pp.83-4).

Neal and Lindeke (2008) believe this entrainment to be equally as valid for infants as adults, having the potential to 'reduce unnecessary energy expenditure for preterm infants', and identify prolonged exposure to lullabies as a form of sedative music that may lower heart and respiration rates by means of entrainment to regular rhythm. Cardiorespiratory responses to music are also directly linked to emotive responses to music, according to Ivan Nyklier *et al* (in O'Gorman, 2007, p.102), specifically those 'of happiness, sadness, serenity and agitation', demonstrating the importance of emotional regulation to physiological regulation.

Findings from a study conducted by Kaminsky (1996, p.48) would appear to reinforce the use of lullabies as having a sedative influence on infants. The study in question outlines the potential benefits of soothing music on the arousal levels of full-term infants in the hospital newborn nursery setting, music defined as: 'Soothing, dreamy arrangements with a flowing, lyrical melody; a quiet, calm tone colour; simple and consonant harmony; and an easy, slow rhythm at approximately the same rate as a regular heartbeat (65 - 80 beats per minute). An example is J. Brahms' *Lullaby*'. Repetition is also a regular feature of lullabies.

Although Kaminsky (1996, p.53) highlights the need for further research into the potential benefits of music, findings from the study suggest that soothing music may reduce the frequency of high arousal states and state lability (behavioural state changes). As a result, infants are more able to adapt to the hospital nursery environment and life outside the womb, and to achieve Kaminsky and Hall's first primary goal for neonates (in Courtnage, 2001, pp.7-8): the self-regulation of behavioural states resulting in homeostasis, necessary to growth and development (see *Stimulation*, p.13).

The second goal, the ability to process and store multiple stimuli, is also supported through music intervention. Neal (2008, p.20) qualifies music as appropriate auditory stimulation for infants due to the acoustical similarities with womb music, and affirms that ‘appropriate auditory infant stimulation is important for normal physiologic, neurobehavioral, and hearing development’. Neal and Lindeke (2008) also identify music as appropriate stimulation for premature infants, evidenced by enhanced physiologic functioning and decreased physiologic instability, which are measured using many of the ‘key indicators’ earlier identified (see *Stimulation*, p.13) (see Table 1).

Table 1

Enhanced physiologic functioning and decreased physiologic instability in infants as a result of music intervention

(Adapted from Neal and Lindeke, 2008, pp. 321-3)

Enhanced physiologic functioning	Decreased physiologic instability
<ul style="list-style-type: none"> • Increased daily weight gain • Strengthened tolerance for stimulation • Increased formula intake • Improved frequency and strength of non-nutritive sucking • Reduction in days to discharge 	<ul style="list-style-type: none"> • Higher baseline oxygen saturations • Fewer episodes of apnoea and bradycardia • Less observed pain • Increased resting behaviour states (more quiet alert or sleeping states than active awake or fussing/crying states), which results in decreased oxygen consumption and caloric requirements so that more calories are available for growth or healing

The data that forms the basis of this table has been extrapolated from a wide range of cumulative research, authoritatively chosen by Neal and Lindeke as representative of the many and varied research studies in the field of music intervention with premature

infants in neonatal care and, as such, negates the need for individual evaluation of the physical benefits of music with this group by this study.

However, there is one method of music intervention within this group of studies that stands out as unique and must be acknowledged independently of the rest: an electronic, non-nutritive sucking device, the Pacifier Activated Lullaby device (PAL), which plays recorded female singing of lullabies in response to sucking by premature infants. The sucking reflex is encouraged by the activation of the recorded music and the intervention, patented by Standley (2000), ultimately results in earlier nipple feeding and increased weight gain.

Doctor Fred Schwartz and music therapist Ruthann Ritchie (2007, p.9) observe that the beneficial impact that music stimulation has on brain growth and synaptic connections in premature infants also holds the potential to counteract developmental delays due to prematurity. In evidence of this they quote a study which measured the effects of the recorded maternal voice on the development of premature infants which resulted in 'significant enhancement in verbal and motor development' at five months of age, with a continuation of this trend when assessed at the age of six.

Music therapist Helen Shoemark (2006) not only advocates music as beneficial to neurological development, she believes it is essential to it, postulating that there are two basic premises which endorse music as a necessity to the healthy neurological development of hospitalised infants. Firstly, that 'music is a safe and positive sensory experience for the newborn infant, including sick newborns', and secondly, that 'positive sensory experiences are necessary for healthy neurological development'.

Music and language

Further to the emotive meaning imparted by adults to infants through expressive vocal improvisations, IDS has profound implications for infant development, which have been identified by Christine Kitamura and Denis Burnham (1998, p.222): ‘Firstly, it engages and maintains infant attention. Secondly, it communicates affect and facilitates social interaction, and thirdly, it facilitates language acquisition’.

Words used as a part of this communication are vocalised using highly exaggerated prosody, engendering speech with a distinctly ‘musical character’. The recurring pitch contours of infant-directed maternal speech provides the first means of informative communication with infants long before lexical and syntactic content is recognised (Stern, Spieker and MacKain, 1982, p.727). According to Steven Mithen (2006, pp.69-70), these techniques are used ‘...because infants demonstrate an interest in, and sensitivity to, the rhythms, tempos and melodies of speech long before they are able to understand the meaning of words’, a theory which would appear to be substantiated by Sandra Trehub (2001, p.1), who asserts that infants show preference for maternal singing over maternal speech. This musical predisposition in child development leads Mithen (2006, p.70) to conclude that ‘...the neural networks for language are built upon or replicate those for music’, establishing music as the foundation for language development.

Music and relationships

The development of attachments is yet another area in which music intervention can give support to infants. A hypothetical model for parental singing as facilitating attachment development is presented by Marianne Bargiel (2002), which sees parental singing as a means of forming secure attachments for developmentally at-risk infants

and as a preventative measure against ‘mental health problems within the familial and societal nucleus’. The essence of this theory is incarnated into practice by researcher and music therapist Lia Barcellos (2006), who in observation of the many challenges and pressures that face the mother of a premature infant in neonatal care, concludes the potential result to be a vulnerability which necessitates a holding environment for the mother. Barcellos provides this containment in the form of music therapy, which both supports the mother emotionally and stimulates her support mechanism for her infant, and draws parallels between the supportive, nurturing character of the therapist-parent dyad with that of the parent-infant dyad.

Music is used as a means of support in a number of ways within the research project discussed by Barcellos (2006). One of the primary means is lullaby singing by the therapist to the mothers, which has the capacity to stimulate maternal singing, supporting the mothers so that they in turn can support their babies, as Barcellos observes:

...such songs are very efficient in the moments of anxiety, abandonment, and in which the mothers seemed to need to be rocked themselves...The lullabies can touch the sensibility of the parents for building the relationship with the baby and, consequently, to the mother function, since this kind of expression can aggregate elements such as the contact through the body, the voice and the eyes. Besides this, the lullabies can make it possible for the mothers to be in touch with their feelings and express them (Barcellos, 2006).

This is despite lullabies not being commonly sung by mothers, who will generally choose to sing songs from popular music culture which are harmonically supported by the music therapist, constituting another means of ‘holding’ the mother.

A study conducted by Karen Milligan *et al* (2002, pp.8-11) measured the expressiveness of communication through song by mothers in relation to their level of

maternal attachment, categorised as ‘Autonomous’, ‘Dismissing’ or ‘Preoccupied’.

Findings indicate that when an infant is distressed, the mother’s ability to respond to her infant using speech and singing to help regulate their arousal level is dependent upon her attachment rating, with Autonomous mothers producing optimal results and Dismissing and Preoccupied mothers producing non-optimal results. It can only be assumed that support of the type expounded by Barcellos (2006) may be beneficial in supporting Dismissing and Preoccupied mothers, or it may even go some way to compensating for this deficiency by providing the necessary vocal regulatory support when the mother is unable, a matter which would need to be investigated through future research.

According to Jennifer Whipple (2000), parent training in music and multimodal stimulation could hold the potential for improved parent responsiveness to infant need. Her study provided a group of parents with approximately an hour’s training in stimulative techniques, infant signs of over stimulation and techniques to avoid overstimulation. As a result, infants experienced significantly reduced stress behaviours. Parents’ actions and responses to their infants were significantly more appropriate and they also reported spending more time visiting their hospitalised infants in the NICU. Despite observing a decreased length of hospital stay and increased average daily weight gain in the infant group, results were too low to be deemed significant.

Standley (1991, p.22) regards parental training in effective parenting skills, specifically including infant pacification and stimulation, as crucial to the long-term development of low birth weight infants. She observes many benefits, asserting that it ‘...can promote bonding, increase the sense of responsibility for the child, reduce stress

from trying to deal with an irritable or dissatisfied infant and promote normal development of the infant's abilities'.

The benefits of music intervention for parents and carers

Infants are not alone in experiencing benefits from music intervention in the neonatal care environment: research has witnessed multiple benefits to both parents and carers. One such attestation is provided by Ayelet Schlez *et al* (2011, pp.354-57), who have conducted research into combined music therapy and KC. Combining these two modalities, specifically live harp music and KC, was found to be 'more beneficial in reducing maternal anxiety than KC alone', a quality that the study concludes to be universal, regardless of the mothers' 'characteristics and personal beliefs, traits or preferences'.

Interestingly, there were no observable physiological or behavioural effects upon the premature infants involved. The study gives several hypotheses as to the reason for this, one being that the multisensory stimulation provided by KC masks the effects of other stimulation and, due to the relative underdevelopment of the auditory system compared to that of the tactile- sensory system which develops first *in utero*, the infant will naturally respond to the tactile and vestibular stimulation of KC, whether or not auditory stimulus is present. Another potential cause is identified as the lack of female voice in addition to the harp, which is considered to be more beneficial than purely instrumental music (p.357).

Such considerations may explain the lack of affect by another similar study conducted with mothers who sang whilst feeding their premature infants. In discussion of the causes behind the lack of affect on heart and respiration rates, duration of feed and volume of fluid consumed, researchers Hugh Blumenfeld and Leonard Eisenfeld

(2006, p.69) conclude that, amidst a myriad of uncontrollable variables, the mothers' lack of comfort with singing may have played a significant part in the results: 'The discomfort and resistance that almost all the mothers exhibited when it came to singing also reflects larger cultural issues that have an impact on parental participation in NICU care'.

Another musical device that has proven successful in helping mothers to cope with infant hospitalisation is having their singing committed to a CD which is subsequently played to the infant in their absence. Research conducted by Andrea Cevasco (2006) revealed that experimental groups of premature and full-term mothers both sang and played music to their infants more than the respective control groups as a result of using such CDs.

In addition to these parental benefits, a study into the impact of music on the health and wellbeing of adults indicates potential benefits to those who sing, purely from the act of singing itself. Clift *et al* (2008) provide an exhaustive list of the perceived benefits of the experience of singing, particularly singing in a group; those that are particularly pertinent to the current discourse include:

Physical relaxation and release of physical tension; emotional release and reduction of feelings of stress; a sense of happiness, positive mood, joy, elation and feeling high; a sense of greater personal, emotional and physical wellbeing; an increased sense of arousal and energy; stimulation of cognitive capacities – attention, concentration, memory, learning; a sense of collective bonding through coordinated activity following the same pulse; the potential for personal contact with others who are like-minded and the development of personal supportive friendships and constructive collaborative relationships; an increased sense of self-confidence and self-esteem; a sense of therapeutic benefit in relation to long-standing psychological and social problems (e.g. depression, a history of abuse, problems with drugs and alcohol, social disadvantage); being engaged in a valued, meaningful, worthwhile activity that gives a sense of purpose and motivation (Clift *et al*, 2008, p.106).

These benefits, when considered in conjunction with the article ‘Music as Therapy’ by Kathi Kemper and Suzanne Danhauer (2005) which explores the premise that music is beneficial for caregivers and patients alike, form a compelling argument for the incorporation of music into medical practice. Although the studies cited by Kemper and Danhauer’s article only pertain to music listening, the conclusions are intriguing:

Providing music to caregivers may be a cost-effective and enjoyable strategy to improve empathy, compassion, and relationship-centered care while not increasing errors or interfering with technical aspects of care...It also has indirect effects [on patients] by modifying caregiver behavior (Kemper and Danhauer, 2005, p.282).

A study which exemplifies the potential benefits of music intervention for caregivers, observed ‘...positive effect[s] on caregiver attitudes, mood and behaviour and, concomitantly, on the infants’ physiological and behavioural state’ as a result of live music therapy in an NICU setting. The accompanied vocal music had a relaxing influence on nursing staff which helped improve their interactions with parents and infants (Arnon *et al*, 2006, pp.134-5).

Culture

Findings from German research into children’s brain responses to music indicate that Western tonal music is integral to the neurological development of children living in the Western world, and that by the age of five, children process music according to the tonal and syntactic principles of Western tonal music (Koelsch *et al*, 2003). It is not yet known whether Western tonal music has the same relevance to children of other cultures or if indigenous music is a necessary part of their development; however, there are certain aspects of Western tonal music that contain characteristics and emotive

meaning that transcend racial and cultural boundaries and are suggestive of music as being a universal medium for adult-infant communication.

One study conducted by psychologists Hella Oelmann and Bruno Løeng (*in* Mithen, 2006, p.91) in 2003 suggests that certain intervallic relationships inspire human emotions that are strikingly consistent between two musical traditions of disparate cultures and times: contemporary Western music and ancient Indian music. The sample group employed for the study consisted of participants who were categorised as either 'Naive', 'Amateur' or 'Professional' in their musical knowledge and who were required to use scales of polar emotions to rate four aural musical intervals: major 2nd, major 3rd, perfect 4th and perfect 5th. Not only did the results demonstrate a high degree of similarity between the Western listeners and between the Western listeners and ancient Indian emotive meaning, but also showed that the understanding of intervallic meaning is not dependent upon musical knowledge, as similarities between the three groups demonstrated (Oelmann and Løeng, 2003).

Lullabies have also been identified as containing cross-cultural characteristics according to research by Trehub, Anna Unyk and Laurel Trainor (1993), whose study required Western adult listeners to identify lullabies from a diverse selection of cultures and geographic regions from around the world. Each lullaby was paired with another song from the same culture that contained similar characteristics, for example tempo, orchestration and vocal style, to make a set of thirty songs. The first two experiments differed only in their participant groups: the first experiment group being taken from within a university community, and the second experiment group from without the university community. Approximately half of each of these groups had no formal

musical training. The resultant findings from both experiments were above those of chance.

In order to ascertain the extent to which lexical ‘cues’ aided the identification of the lullabies, experiment three employed electronic filtering to make the words of the songs unrecognisable and experiment four substituted electronically generated versions of each lullaby. Although the results indicated that language did indeed play a part in the identification process, results for experiment three were still above chance; however, the total elimination of vocal cues in experiment four demonstrated their necessity to lullaby identification. Results from all four experiments demonstrated that musical training and familiarity with the musical culture from which the music originated were irrelevant to successful lullaby identification, which may indicate ‘cross cultural universals in the perception or interpretation of songs’ (Trehub, Unyk and Trainor, 1993, p.205).

Gender

An infant’s physical capacity for hearing differs according to gender, a difference that may be responsible for inconsistency in infant responses to music according to research by Jane Cassidy and Karen Ditty (2001, pp.33-4). Male full-term infants’ ability to hear high frequencies is significantly diminished compared to that of females, a differential which music therapy practice needs to compensate for in order for both genders to benefit equally. However, the high frequencies under discussion are outside the range of the human voice and only apply to the timbral quality of certain instruments, which serves to reinforce the use of singing as an ideal medium for music intervention with infants and may also indicate the existence of factors beyond gender differences in hearing sensitivity to account for the inconsistencies of responses to music. One

potential factor has been identified by similar research conducted by T. Morlet *et al* (1995), whose findings suggest that the rate of auditory development differs between the sexes in premature infants.

In a more recent study, the effects of developmental multimodal stimulation on premature infants provide further evidence of differences in gender responses to music. Darcy Walworth *et al* (2011, p. 10) observe that males benefitted more from exposure to singing alone as opposed to singing accompanied with guitar playing, benefits which were converse for females, with both sets of results being evidenced by a significant reduction in the number of days to discharge from hospital. Due to these gender differences in the hearing of both full-term and premature infants, music intervention in the neonatal setting must find a means of compensating for this disparity.

From this evidence it would be natural to conclude that hearing impaired infants would not benefit from music at all; however, this is not necessarily the case. Although infant specific research has yet to be conducted, evidence from American research shows that ‘brains of deaf people rewire to “hear” music’: the area of the brain that processes auditory stimulation in a hearing person adapts in that of the deaf to process musical vibration (University of Washington, 2001), indicating that a hearing impaired infant may benefit from early exposure to music, but there may be implications for its delivery.

Infant preference and infant-directed singing

Not only do infants recognise melodies experienced *in utero* for more than a year after birth (see *Sound, music and intrauterine development*, p.21), they show preference for this music over similar music that they have previously not heard (BBC News, 2001).

Infants also prefer consonance to dissonance in music, as identified in a discussion of

the links between music and language by Erin McMullen and Jenny Saffran (2004, p.298), who acknowledge that infants from as young as two months of age have been shown to exhibit such a preference, ‘...[which] has long been posited as an important underpinning of emotion in music’, and that infants show preference for higher-pitch music, which research has associated with positive emotions.

Emotion is also conveyed through infant-directed singing and music as it is through IDS (see *Sound, music and intrauterine development*, p.21), all of which infants show preference for over adult-directed speech, singing and music (McMullen and Saffran, 2004, p.295). Infant-directed singing shares many of the characteristics of IDS, such as ‘higher pitch, wide pitch range, and short melodic phrases followed by long pauses, slow pace, smooth, simple and highly modulated intonation contours, and much repetition’ (Shoemark, Wolfe and Calabro, 2003), and can be seen as an extension of this practice, as ‘In both domains, the affective properties of infant-directed register appear to be central; before the availability of other forms of communication, the prosodic contours of these two domains are a primary means of transmitting emotional information’ (McMullen and Saffran, 2004, p.295). However, live maternal singing has been found to have a greater effect on infant arousal than infant-directed speech in its ability to promote homeostasis (Trehub and Nakata, 2002, p.51).

One reason for infant preference of infant-directed singing over adult-directed singing could be attributed to recognition of repeated songs. A series of experiments conducted by Saffran and Gregory Griepentrog (*in* Mithen, 2006, pp.76-7) suggest that infants are born with the ability to recognise absolute pitch as opposed to relative pitch, a predisposition that is lost through childhood if not maintained through practise. This gives them the ability to recognise infant-directed songs sung by caregivers, as these

tend to be sung consistently in the same key using the same pitches, even on different days (McMullen and Saffran, 2004, p.295); consistency in tempo between these performances has also been noted (Trehub and Nakata, 2002, p.37).

According to the study conducted by DeCasper and Fifer (1980, p.1174), infants as young as newborns prefer the maternal voice to a non-maternal voice, a theory which has been directly challenged by Jacquelyn Coleman *et al* (1998, pp.9-10) in their more recent study, which measured the benefits of both male and female singing and speaking for premature infants in a NICU. Their findings indicate that the infant participants responded equally to male and female voices, with singing producing a more positive response than speech. This theory is reinforced by Trehub and Takayuki Nakata's (2002, p.50) research, which propounds that, while infants prefer maternal infant-directed speech and singing to speech by a stranger, infant-directed singing by a familiar or unfamiliar voice is equally effective at averting infant distress. Such conflicting results indicate the necessity for further research into this area.

O'Gorman (2007, p.103) postulates that a parent who is able to perform infant-directed singing meets a specific set of criteria. Firstly, that the parent is 'available' to provide an active role in the care of their infant following a period in which their ability to do so was inhibited. Secondly, that the parent has a 'coherent' relationship between their actions and emotions through supportive engagement with the infant, and is musically 'responsive' to infants' cues that indicate changes in need; the parent is also 'synchronous' to these changing needs through the nature of delivery of their improvisation. Finally, the parent is 'reciprocal' to their infant, providing infant-directed singing as part of an interactive 'dialogue' in response to infant cues.

The latter two points are definitive of infant-directed singing, as it is prescribed by O’Gorman for the purposes of her study, consisting of:

...the improvised use of voice to create song-like vocalisations in the baby’s presence. Infant-directed singing is organised around various ‘elements’... ‘...melody, pulse, rhythm, harmony, tempo, pitch, timbre, attack, duration, register, dynamics, phrasing and silence’... While the singing may resemble nursery or other song material, the nature of the vocalisation is such that it is created in the moment, rather than being drawn from popular repertoire (O’Gorman, 2007, p.103).

The principle article referenced by O’Gorman in relation to this topic is authored by Shoemark (2006) who, in a later article, elucidates the importance of improvisation in infant-directed singing as a means of introducing new experiences to the infant in a supportive way. Familiar repertoire engenders the experience of expectation in the infant and acts as a stronghold from which to venture into new improvisatory experiences, through which ‘...significant events may occur for the medically fragile newborn infant’.

It is evident from research that parents do indeed naturally modify many of the musical ‘elements’ referred to by O’Gorman (2007) in their performance of infant-directed singing in the presence of their infant. A study conducted by Trainor *et al* (1997, p.383) found acoustic differences between pairs of lullabies and play-songs performed both in the presence and absence of infants. For both song types the elements of tempo, duration, pitch and timbre were found to be modified in infants’ presence in the following ways: ‘...the tempo was slower, there was relatively more energy at lower frequencies, inter-phrase pauses were lengthened, and the pitch and jitter factor were higher’.

A similar study published in the same year saw adult listeners successfully distinguish between infant-absent and infant-present renditions of songs performed by both mothers and fathers. Slower tempo and higher pitch differences were found to be two distinguishing features of infant-present renditions, which were also identified by adult listeners as more emotionally engaging (Trehub *et al*, 1997, p.500). Interestingly, the study found maternal and paternal song modifications to be comparable; however, this cannot be seen as conclusive evidence as the study itself emphasises, as fathers contributed only 14% of the singing for the study, a reticence which is apparently common in fathers but less so in mothers (Trehub *et al*, 1997, p.505).

Although these modifications cannot be seen to constitute true improvisation, they can be seen as responsive. In many cultures, improvisation forms part of a strong aural tradition in music, yet in the West traditions of this kind have largely been lost, which may account for much of the reticence exhibited by parents towards singing (Blumenfeld and Eisenfeld, 2006, p. 69). As many parents are not comfortable with singing in the first instance, adding the requirement for public self-expression and improvisation may act as a complete deterrent, indicating a necessity to provide new experiences for the infant through a means other than that of parental-infant directed singing.

There are several factors already discussed within this study that demonstrate the efficacy of infant-directed singing as a music intervention with infants in neonatal care, be it maternal or non-maternal: singing engages and maintains infant attention, inculcates language development (Kitamura and Burnham, 1998, p.222), imparts emotional meaning and facilitates social interaction (Kitamura and Burnham, 1998, p.222; McMullen and Saffran, 2004, p.295), is favoured over speech by infants

(McMullen and Saffran, 2004, p.295), can extend the learning continuum of womb music (Neal and Lindeke, 2008, p.20; Parncutt, 2009, pp.188-91) and provides emotional support to the mother, in turn supporting the infant (Barcellos, 2006).

A further benefit of infant directed singing is presented in a study which addresses the differences in infant behaviour states when exposed to lullabies versus play songs. Adult raters were asked to distinguish between a play-song style rendition and lullaby style rendition of a song chosen and sung by individual mothers, which was achieved without exception. Adult observers were then asked to distinguish between infant reactions to the different song renditions from silent video recordings, which produced above-average positive identification. Infant behaviour was analysed during exposure to the singing, and findings indicate that infants' focus is more internalised when listening to lullaby style singing and more externalised during play-song style singing. The conclusions drawn by the researchers suggest that the two styles of singing can influence control of infant behavioural states and communicate emotional information that differs between the two styles (Rock, Trainor and Addison, 1999, pp.527-32).

The infant participants employed for this study were six months of age, and were presumed to have considerable experience of infant-directed singing, which would indicate the importance of infant-directed singing from an early age (Rock, Trainor and Addison, 1999, p.532). Whether the same behavioural influences are applicable to younger infants cannot be determined from this study; however, these results are indicative of a general difference between lullaby singing as pacification and play-song singing as stimulation. The profound consequences of the potential for infant-directed singing to regulate infant states is summarised by Trehub and Nakata (2002, p.46) in

relation to their own findings: ‘If musical speech and singing to infants succeeded in regulating infant arousal, as they seem to do so, these vocal devices would increase the joys of caregiving, with corresponding reductions in the inevitable burdens’. The regulation of infant arousal is just one of the many attributes of infant-directed singing that are unique to this medium and are not present in adult-directed singing or instrumental music, potentially endorsing infant-directed singing as the most favourable choice for music intervention with infants in neonatal care.

Music content

Just as music has been demonstrated to hold the potential to be beneficial to infants in neonatal care, it also has the opposite potential. It is therefore important to give careful consideration to every aspect of the music utilized for such intervention. Music that adheres to the characteristics earlier outlined as sedative music such as lullabies (see *The physical benefits of music intervention*, p.24), is generally considered appropriate music for these vulnerable infants (Kaminsky *in* Courtnage, 2001, pp.7-8; Shoemark, Wolfe and Callabro, 2003; Standley *in* Neal and Lindeke, 2008, p.324). Important characteristics to avoid are highlighted by Schwartz and Ritchie (2007, p.10) as ‘...abrupt tempo changes...Complexity of sound timbre and colour... complex combinations of different instruments [and] ...Transient changes in amplitude’, the latter necessitating the fading in and out of sound in order to avoid infant startling according to Standley (*in* Neal and Lindeke, 2008, p.324). While Standley advocates the use of piano music ‘...because the neurocognitive responses of children to it have been found to be clearer and more mature than responses to tones of other instruments’, she is circumspect regarding music that has not been endorsed through research ‘such as live instrumental performances in the NICU, radio stations, and toys that generate music’.

As an infant develops, requiring more stimulating interaction and less pacification, the role of play songs, such as nursery rhymes, comes to the fore (Trehub and Trainor, 1998, p.53). However, many play songs can be effectively adapted to be sung in a lullaby style and *vice versa* as both contain many similar characteristics, such as simple melodies, regular rhythm and repetition. The use of songs within the study conducted by Adrienne Rock, Trainor and Tami Addison (1999) (see *Infant preference and infant-directed singing*, p.36), which were chosen by mothers and adapted into both play-song and lullaby styles, would indicate that the style in which a song is sung is of principle importance, suggestive of a potential for a wider range of popular repertoire to be suitable for this purpose.

Few studies provide lists of appropriate, well-known songs for use with infants in neonatal care, and there is an apparent lack of research into the comparative effects of individual songs. A representative list of songs and CD resources from research studies that provide perceived beneficial outcomes is featured in Appendix F; however, for UK practice these lists would need revision, as many of these songs may not be so widely known in the UK as in the USA.

Live versus recorded music

The intriguing results from an Israeli study conducted in 2006 indicate that the means of transmission may be vitally important in the provision of music intervention with neonates. The study in question explored the difference in affect of live versus recorded music on premature infants aged thirty-two weeks (post conception) or more in a NICU. Thirty minutes of live music therapy, recorded music therapy and no music therapy was provided on a random basis to groups of three infants over a period of three days. The live music therapy comprised wordless, lullaby style female singing, which combined

both Western and Eastern musical elements in inclusive consideration of the various cultural backgrounds of the infants within the control group, accompanied by harp and Eastern frame drum.

Eliana Gilad and Schmuel Arnon (2010) explain the reasons for these instrument choices in a more recent article, in which they discuss the ‘environmental, cultural and philosophical considerations’ behind the study. Wordless singing was employed for a number of reasons:

Ancient healing and transformational music is based on the premise that wordless singing embodies inherent healing qualities. The significance of singing, as Loewy points out, has been recognized by civilizations since the beginning of human history. Wordless singing holds many advantages: It utilizes the nutritive essence of sound at its fundamental level. It is believed to bypass the intellect, allowing the brain to relax. It can also bypass the constraints of someone not understanding the words being sung. Wordless singing has been implemented in a music therapy developmental framework where crying comfort sounds precede phonemes and tonal vocal holding leading to phonemic musical play enhances reciprocal vocalization between infants and caregivers. Researching the effects of wordless singing in this context served to highlight the advantages of implementing it in an NICU setting (Gilad and Arnon, 2010).

The Eastern frame drum and harp were chosen to accompany the singing for their cultural and historical associations, having been depicted on ancient artefacts found in the Near East as being played by women. The music was designed to emulate womb music, being ‘soothing, rhythmic, repetitive... [and] constant’ (Arnon *et al*, 2006, pp.132-4). The same music was provided as recorded sound for comparison. Infant behaviour was scored and physiological changes monitored by specially trained nurses to determine infant short-term stress parameters.

A ‘Musical Model’ was designed to structure the application of the music therapy within the hospital context in order to work effectively within the potentially

disruptive nature of the environment. The model consisted of five elements which were drawn from ancient Eastern musical traditions. The first element, 'Silence and Focus', was based upon Ancient writings by Maimonides. Silence was introduced gradually by the harpist and vocalist by slowly reducing the volume of the music to end the therapy. By encouraging focus on silence within the unit, environmental stimulation was minimised while therapy took place. The second element, 'Long Single Note', incorporated the use of drone notes to gently introduce sound in a non-disruptive way and, by singing one note per breath, emulating the auditory experience of the womb, creating a sense of wellbeing.

The recreation of womb music also acts as a basis to the third element, 'Heartbeat', with constancy provided through ostinato rhythm. When equipment beeping occurred it was incorporated into the rhythms and melodies of the music, which was also entrained to infant breathing. This would often result in the equipment noise ceasing, in which instance the music would give way to silence.

'Rhythm', the fourth element, was applied in the context of Eastern music tradition: rhythm being integral to melody and inseparable from it, otherwise known as metro-rhythmic. Rhythm is also traditionally used in medical contexts, with specific rhythmic modes having associated medical applications. 'Melody', the final element, has similar associations, with its use based upon ancient application in medical settings and, when used wordlessly in conjunction with the other elements, the listener's intellect is bypassed.

The results of the study indicate that, whilst recorded music therapy and no music therapy produced no influence on test parameters, live music therapy produced improvements in behavioural and physiological short-term stress parameters, both

during and following the intervention. One observable physiological benefit was decreased heart rate which was lowered during the intervention, but only reached a statistically significant level during the thirty minute interval following the end of the intervention. Within this post-intervention interval respiratory and oxygen saturation rates also improved, but not within statistically significant parameters; thirty minutes after therapy ended infants also experienced calmer, deeper sleep. The length of positive affect time that live music produces cannot be determined from this study, as monitoring only occurred thirty minutes before, during and after therapy due to practical constraints (Arnon *et al*, 2006).

Arnon *et al* (2006) speculate that live music may possess attributes that do not transfer to the recorded medium, the use of which in neonatal settings is condemned by nurse researcher Kathleen Philbin (2000):

There appears to be little or no basis for exposing hospitalized sick and preterm infants to tape recordings regardless of their content. Not only are the purported benefits not established, the possible negative short-term and long-term consequences are largely unexplored. Additionally persuading parents and staff to expose hospitalised infants to tape recordings tends to place a nonresponsive machine between the caring person and the infant (Philbin, 2000, p.S84).

Live music can certainly be used more responsively than recorded, and the fact that infant presence modifies parental infant-directed singing suggests that live vocal performance for infants cannot be emulated out of context (Trehub *et al*, 1997, p.505).

Provision of music intervention

Based upon their appraisal of research in the field of music intervention for premature infants, Neil and Lindeke advocate the list of recommendations for the provision of music intervention posited by Standley in her study of 2002 entitled *A Meta-Analysis of the Efficacy of Music Therapy for Premature Infants*:

- Beginning music interventions around 28 weeks gestational age
- Using soothing, constant, stable, and relatively unchanging sounds with a female voice alone or only one accompanying instrument to reduce alerting responses
- Having a light and constant rhythm
- Including melodies in the higher vocal ranges that infants hear best
- Ensuring a maximum time of 1.5 hours per day for playing music in short intervals of 20 to 30 minutes per session at critical periods such as at the beginning of sleep, quiet times, and immediately after stressful procedures (Standley *in* Neil and Lindeke, 2008, p.323).

Standley also recommends that recorded lullabies should be played to infants from twenty-eight weeks gestational age and live infant-directed singing provided from thirty-two weeks gestational age; however, reappraisal of this recommendation is necessary in light of her updated meta-analysis of 2011. In utilizing the evidence-based NICU-MT (music therapy) protocols formed as a result of the analysis, Standley (2011, p.11) asserts that ‘...it is important to note that the research shows that live music would be more effective than recorded and that clinical usage must be matched to individual patient gestation age, weight, gender, responses, and indicators of readiness’.

This would indicate that rather than playing recordings of lullabies to infants from twenty -eight weeks gestational age, repetition of a small number of live infant-directed lullabies may be more efficacious, with the introduction of additional lullabies from thirty-two weeks gestational age and play songs when further stimulation becomes appropriate to developmental need.

NURSING AND PARENTAL PRACTICE

Nursing and music intervention

It is apparent from the evidence hitherto evaluated that the most desirable candidates for the delivery of music intervention with neonates are the parents of the individual infant, and that the most efficacious form for this music intervention is that of infant-directed singing. However, there are many circumstances surrounding infants in neonatal care that could potentially form a barrier to this as a consistent practice. One such circumstance is parent absence, which can be due to a number of factors, not least the lack of available intensive care cots within localised NHS Neonatal Networks.

In 2003 the English Government implemented change in the organisation of neonatal care, creating twenty-three regionalised, managed neonatal networks capable of providing comprehensive care for both mothers and infants within the network, negating the need for long-distance transfers to other units for specialist treatment. These transfers have indeed seen a significant reduction since the organisational change; however, with only seventeen of the networks meeting the 95% target of treating infants autonomously, long-distance transfers remain a cause of parent-infant separation (Bourn, 2007, pp.8-9).

In order to promote family-centred care in such adverse circumstances, the *Toolkit for High-Quality Neonatal Services* details the provision of free overnight parental accommodation for parents of infants in NICUs as standard. To meet this target an additional 250 rooms still need to be provided in England (Kirrane, 2010, p.4).

Even for parents who are not affected by access problems there remain many other common obstacles that could potentially prevent parents from providing effective

music intervention. On a practical level, having an infant admitted into neonatal care can cause financial strain on the parents, who not only face visiting-related costs such as regular travel expenses and hospital parking charges, but also frequently loss of earnings when taking leave from employment, with the average cost to parents in England being £2,800 (Kirrane, 2010, p.4).

All of these practical burdens serve to aggrandize the psychological and emotional strain of the situation for parents which, in some cases, can lead to traumatic-stress symptoms, commensurate with those experienced with Acute Stress Disorder or Posttraumatic Stress Disorder. In an American study which measured these symptoms in parents of infants in NICUs, only mothers, of which 44%, were found to exhibit symptoms which met the full criteria for Acute Stress Disorder. Loss of parental role, a common experience for parents of hospitalised infants, is one associated cause for such symptoms, and vulnerability is increased in parents of seriously ill infants and those who have experienced prior infant-related trauma (Kendall-Tackett, 2009, pp.16-18).

Mothers, especially of seriously ill infants, may also experience anticipatory grief for the loss of their infants or postnatal depression. While anticipatory grief causes mothers to distance themselves from their infants, postnatal depression can result in maternal thoughts of causing harm to herself or her infant, a lack of desire to care for her infant and poor mother-infant interaction (Kendall-Tackett, 2009, p.16; Nurse, 2009, p.377). At present, England cannot be seen to be providing enough support for such struggling parents, with only 49% having access to counselling services (Kirrane, 2010, p.9).

There are also mothers whose substance abuse may inhibit or prevent infant bonding and the necessary sense of responsibility for the care of her infant, whose

vulnerability is often increased through being born drug-addicted themselves (Nurse, 2009, p.474). Approximately 1% of pregnant women are classed as ‘problem drug users’, and are therefore at higher risk of premature birth. Their drug-addicted infants, premature or not, require immediate neonatal intensive care and are frequently placed in the care of the local authority (Crichton, 2010; Best Beginnings, 2012).

The many, detrimental factors surrounding the parents of infants in neonatal care not only constrain autonomous mother-infant attachment, which Milligan *et al* (2002) identify as a necessary prerequisite to effective infant-directed singing (see *Music and relationships*, p.28), but also the parental capacity to meet the necessary criteria for engaging in infant-directed singing expressed by O’Gorman (2007) (see *Infant preference and infant-directed singing*, p.36). Parental capacity could conceivably be increased through musically ‘holding’ the parent as indicated by Barcellos (2006), and could potentially be achieved through neonatal nurse infant-directed singing, as nurses are required to support parent-infant interaction as part of family-centred care (see Appendix E, no.8) and have regular, consistent contact with infants, providing the potential for consistency in music intervention during parental absence.

Within Schwartz and Ritchie’s (2007, pp.11-13) article entitled ‘Music Listening in Neonatal Intensive Care Units’ they provide recommendations for ‘Setting up an NICU Sound System’, which emphasise the nurse as a pivotal figure in the provision of recorded music intervention. Their recommendations are based upon their own experiences at Piedmont Hospital in Atlanta, USA, where ‘the neonatal nurses choose the timing, frequency and duration of music interventions, as well as which music selection is played’. This is not only a costly process to initiate, but it also lacks the responsiveness of live music-intervention; however, it does serve as a working example

of the practical incorporation of music intervention into nursing routines. By participating in infant-directed singing, neonatal nurses could potentially counteract some of the workplace pressures brought about, not only by the nature of the job, but also as a result of staff shortages.

Rather than add to the workload of already overstretched nurses, infant-directed singing could potentially be performed as part of developmental care, which may offset the effects of, and also help infants settle following, disruptive interventions such as nappy changing. This recommendation can be seen echoed in the words of Schwartz and Ritchie (2007, pp.2-3), who observe: ‘The inclusion of playing music and other sounds is a natural extension to the practice of developmental care’.

Dr. Deanna Hanson-Abromeit (2003) also draws parallels between music intervention and developmental care in her study, which seeks to integrate the NIDCAP model of developmental care into music therapy practice based on three principles: ‘Individualizing interventions, providing balanced sensory stimulation, and parental involvement’. To this end, she correlates beneficial outcomes from both disciplines, demonstrating their congruence (see Table 2).

Table 2

Music therapy outcomes in relation to NIDCAP outcomes (Hanson-Abromeit, 2003)

Music therapy	NIDCAP
Decreased length of stay	Decreased length of stay
Improved behavior state	Improved neurobehavioral organization
Increased oxygen saturation levels extubated sooner	Decreased days on ventilator and supplemental oxygen
Promotes intimacy between parent/ infant	Increased parent infant bonding
Increased mean weight gain	Increased daily weight gain
Improved non-nutritive sucking	Earlier nipple feeding

Specialist therapeutic or musical knowledge is not a prerequisite for providing music intervention, as Vera Brandes (2009), director of the MusicMedicine Research Program at Paracelsus Medical University in Austria, indicates:

MusicMedicine is the term used to describe music interventions based on physiological and psychological parameters that, contrary to active forms of Music therapy, do not require a musician who is trained as a music therapist. 'For today reliable evidence exists to confirm that music produces reproducible effects and has valuable therapeutic properties...' MusicMedicine implements music as a therapeutic medium in medical treatment. The patient listens to music that has been selected for him or her by the therapist, whereby the music takes on the role of a prescribed intervention (Brandes, 2009, p.83).

It is unclear whether Brandes is referring to recorded music in this statement; however, its pertinence to neonatal nurse music intervention is unaffected. The music employed for infant-directed singing in neonatal care is preselected as lullabies and play-songs by ancient, cross-cultural tradition, and is further endorsed through effective use by several of the research studies explored within this study; its responsive use is a natural part of

adult-infant interaction and it requires no musical knowledge or training on the part of nurses or parents.

Ruth McCaffrey and Rozzano Locsin (2002), Assistant Professor and Associate Professor respectively at Florida Atlantic University, USA, who also assert that musical knowledge is not necessary in order to use music as a healing intervention, champion the integration of music listening into nursing interventions in their article of 2002. The article outlines a guide for practice, employing recorded music listening for adult clients based upon six essential principles. Among these principles entrainment to music is identified as an achievable nursing practice through use of the iso principle, which

...states that the mood or tempo of the music in the beginning must be in iso relation with the mood or tempo of the person... If the person has a fast heart rate, playing music at that rate and gradually slowing the tempo has been demonstrated to reduce the heart rate. An understanding of the iso principle will allow the nurse to use music listening at the appropriate speed and volume to entrain the body and mind and then to change those parameters to enhance healing (McCaffrey and Locsin, 2002, pp.75-6).

Through a practice which employs nurse infant-directed singing as a consistent basis, supplemented by parent infant-directed singing or *vice versa*, it may be possible to provide infants with the 'new experiences' expounded by Shoemark (2006) (see *Infant preference and infant-directed singing*, p.36). Through consistent use of the same repertoire by all parties as a foundation, the natural changes which would occur in all the listed elements between individuals' performances may qualify as 'new experiences'; however, this is an avenue for further research, as these changes would not be produced responsively as part of infant engagement, but as a result of the unique characteristics of individuals' voices and performances.

It would seem that nursing may already be starting to embrace music into practice. Florence Nightingale, a nurse famed for her empathy, valued music as beneficial to the sick; adopting both her name and her philosophy, the Florence Nightingale School of Nursing and Midwifery at King's College, London now operates a 'Culture and Care' programme for staff and students, which endeavours to incorporate creativity into the education of nurses and midwives (King's College London, 2011). Integral to this aim has been the residency of composer John Browne (*in Elliot, 2010*), who was commissioned to write a book of children's ward songs for use by nurses to "soothe, distract or explain", as he puts it. He continues:

Music is essential in life. People need creativity and quite often in life when they are in hospital that is lost...It is about trying to find a different way rather than looking solely at the Nice (National Institute for Health and Clinical Excellence) guidelines or Department of Health guidance, and about getting students to think in a more narrative way...Many people who have been nursed in hospitals find the difference between the excellent nurse and the OK nurse is not any tangible thing they do...Rather, it is the way that they do it, and that requires an art - rather than a science - way of teaching (*in Elliot, 2010*).

Globally, the awareness of the potential for music as medicine is also increasing, and there are even some instances of medical staff participating in music intervention. In Istanbul Memorial Hospital, two doctors, Dr Bingür Sönmez and Dr Erol Can, play instruments together at patients' bedsides, a practice they believe 'can produce significant psychological and physiological outcomes'. The music therapy is based upon one-thousand-year-old practices using *makam*, a musical mode only occurring in Turkish and Arabic music, which '...defines the pitches, patterns and development of a musical piece. The term refers to a very wide variety of different tone scales that must be largely learned by ear'. Each *makam* has its own character, each individual medical condition requiring the use of a different *makam*. Sönmez and Can use music therapy as

a complement to existing treatments, providing patients with five to ten minutes of music in order to reduce heart rate and blood pressure, and occasionally playing for colleagues during breaks; as Sönmez says “That way, everybody is cared for” (Letsch, 2011).

Nurse training

Few nursing textbooks make reference to the beneficial use of singing in relation to the regulation of infant behavioural states; those that do make but a passing reference, without any instruction or background information as to its delivery and do not present it as a requirement within general practice. However, nurse training in monitoring and responding to infant behavioural states engenders them with the knowledge to practise infant-directed singing effectively, safely and responsively, without causing undue stress or overstimulation. This training is vital to the practice of music intervention in neonatal care, as evidenced by Walworth *et al* (2011, p.13) in relation to research in the field: ‘A critical barrier to progress in this line of research is the application of music being used with premature infants by individuals without specialized training for the NICU environment’.

Parents would also not be in a position to engage in infant-directed singing in neonatal care without trained support or training akin to that provided by Whipple (2000) (see *Music and relationships*, p.28). As minimal training provides such beneficial outcomes, it may that a similar training could be provided through observation of nursing responses as a part of family-centred care (see Appendix E, nos. 5, 6 and 8), in tandem with supporting parental music intervention through nurse infant-directed singing.

Given that the neonatal unit environment can disrupt the relationship between mother and infant, it follows that introducing further professionals into the environment, even if to help re-establish the disrupted relationship, extends the broader context with which the infant must directly relate in the absence of the fundamental relationship of the primary attachment figure, through which they would otherwise experience the broader context (O’Gorman, 2007, pp.101-4). As nurses’ presence is an inalienable part of this broader context, it is preferable for support in establishing parental attachments through infant-directed singing to be provided by these existing carers. The number of people visiting a ward is generally restricted in order to limit the risk of infection; the introduction of professional music therapists into the ward on a daily basis would not only increase this risk but would incur significant costs for the NHS who already lack the funding to pay a sufficient number of nurses.

Neonatal nurse infant-directed singing would by no means negate the need for specialist music therapy, but rather introduce its basic elements into standard, daily practice for the benefit of everyone in neonatal care. There are definite limitations to this practice: to take infant-directed singing beyond the basic use of lullabies and play-songs and provide responsive improvisation based on complex musical principles, as in the study conducted by Gilad and Arnon (2010), would require specialist training in music therapy. Such training would also be necessary for the provision of specialist, individualised music therapy, which is a necessary additional intervention for seriously ill infants and those with severe neurological impairment. The distinction between the role of nurses and therapists in the provision of music intervention as proposed by this study is effectively summarised by McCaffrey and Locsin (2002) in regard to music listening:

The ability of nurses to use music listening as an intervention does not conflict with the need for other professionals who use music. Music therapists use music as a systematic application to assist in the treatment of the physiologic and psychological aspects of illness or disability. Trained music therapists have skills in composing and in identifying music for specific therapeutic outcomes. Nurses, in their daily interactions with patients, can use music listening to provide an environment to facilitate healing and wellbeing (McCaffrey and Locsin, 2002, pp.71-2).

In order for infant-directed singing to become a part of standard nursing practice, it would need to be incorporated into nurse training. However, this would potentially be minimal, consisting of instructions for its delivery designed by a professional music therapist, based on recommendations established through research studies such as those of Standley (*in* Neil and Lindeke, 2008, p.323) (see *Provision of music intervention*, p.46) for practice and Schwartz and Ritchie (2007, pp.13-14) (see Appendix F*Music content*) for repertoire in addition to any other recommendations arising from further research and comfort with singing. The latter could be provided through choral singing, as already practised by the Florence Nightingale School of Nursing and Midwifery, which may be made financially achievable through collaboration with charitable choral organisations such as Sing UK and Sing for Pleasure, the potential for which would require further research.

The incorporation of infant-directed singing into nurse training in England could potentially be delivered through developmental care training programmes by independent organisations such as NIDCAP, which are designed for existing healthcare professionals working in neonatal care; however, as this training is currently discretionary, this would not ensure standard practice.

A further avenue for future nursing practice may be presented by infant recognition and preference for music experienced *in utero* (see *Sound, music and*

intrauterine development, p.21 and *Infant preference and infant-directed singing*, p.36).

The efficacy of music intervention *ex utero* may be increased if it were preceded by parental infant-directed singing during pregnancy, the instigation and encouragement for which could be provided through nursing practice.

This study also recognises the potential of including music as part of multimodal stimulation, as advocated by Standley (2011) and Whipple (2000); however, this practice goes beyond the scope of the present study and would need to be the subject of further research for delivery within the context of nursing practice.

Financial implications

Training in infant-directed singing would inevitably incur costs to the provider, the extent of which would need to be determined through further research; however, the potential for financial savings for the NHS as a result of the beneficial impact on infants is significant.

Through provision of recorded music intervention for premature infants in a NICU, a study conducted by Schwartz *et al* (1998) observed infants leaving the NICU more than three days earlier, which resulted in a financial saving of \$2,000 to \$9,000 for each infant, the equivalent of approximately £1,288 to £5,796, which today, fourteen years on, would be considerably higher. As the suggested intervention employs live as opposed to recorded music intervention, the outcomes would potentially be even greater.

Although financial benefits of music intervention specific to neonatal care have yet to be the subject of research in the UK, it has been shown to cut costs in other areas of clinical practice. In a paper evaluating research and evidence pertaining to the use of

arts in UK healthcare by ‘the UK’s leading independent arts consultancy specialising in arts and health’ Willis Newson (2010, p.1), it is observed that ‘...arts-based projects are seen as an effective and “value-for-money” means of creating impact and ensuring appropriateness’. Addressing the international role of music in healthcare, a paper commissioned by the Musical Connections Programme of Carnegie Hall’s Weill Music and authored by Lea Wolf and Dr. Thomas Wolfbrown (2011), identifies music as a cost-effective intervention benefitting a diverse range of medical conditions, including cancer, schizophrenia, traumatic brain injury and chronic pain. The financial implications summarised within the paper are encouraging:

...today music is integrated into health care at every level. The clinical use of music is now an evidence-based practice that has been proven both to satisfy patients and, very significantly, to lower the cost of care... The strategic use of musical intervention has been shown to address the defining reality of healthcare cost. Effectively and appropriately deployed, music is a relatively low-cost intervention (Wolf and Wolfbrown, 2011, pp.iii-10).

Questionnaires

To introduce infant-directed singing successfully into neonatal care settings both parents and nurses would need to be willing participants. In order to ascertain the compliancy of these groups anonymous questionnaires were designed (see Appendix G), aimed at establishing whether there exists a firm enough foundation from which to pursue further research into parental and nurse infant-directed singing.

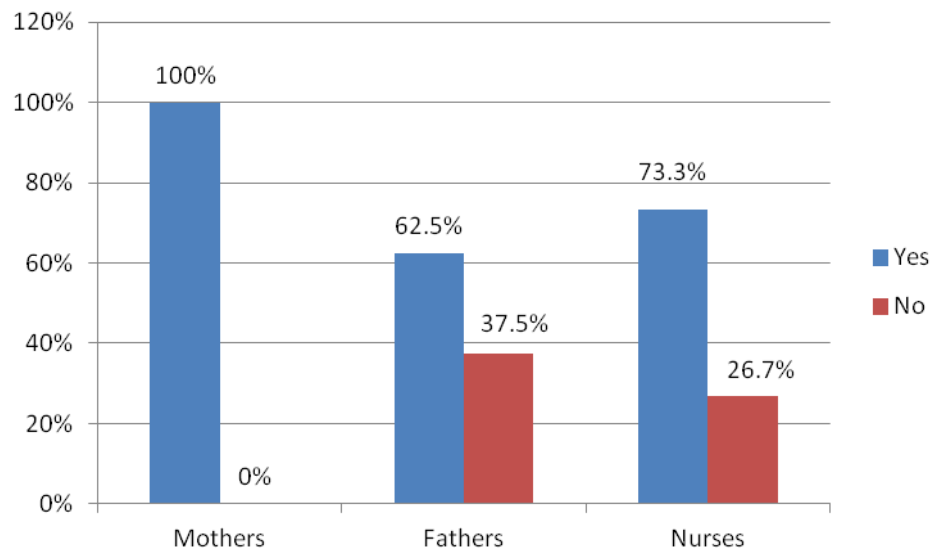
The participant samples employed were convenience samples, consisting of parents and nurses willing to complete the questionnaire, sourced from the neonatal unit at Russell’s Hall Hospital, Dudley, UK. Permission was sought from and granted by Julie Marks, ward manager of the neonatal care unit, to issue questionnaires to parents and nurses within the unit in June 2011, with questionnaires issued in the subsequent

month. The groups comprised fifteen participants in the sample group of nurses and seventeen participants (eight mother/father couples and one mother) in the sample group of parents. A Participant Information Sheet accompanied the questionnaire, in fulfilment of the University of Wolverhampton's ethical guidelines (included in Appendix G1). Participant questionnaires were number coded for analysis identification purposes; complete collated results tables are contained in Appendix H.

Although the collected data lacks the breadth and rigour to be classed as genuine, scientific research from which conclusions can be drawn, it is suggestive of an above average positive response to infant-directed singing by parents and neonatal nurses, potentially indicating a viable avenue for future research. The data results indicate that, on the premise that new research suggests that infant-directed singing by mothers and fathers is beneficial to the health or wellbeing of premature infants, all nine mothers (100%) were prepared to sing, regardless of feelings of embarrassment, compared to only five out of eight fathers (62.5%). The neonatal nurse group proved to be more compliant than the fathers: on the basis that neonatal nurse singing was suggested as beneficial to the health or wellbeing of premature infants by new research, eleven out of fifteen nurses (73.3%) indicated that they were willing to sing as part of their care provision (see Figure 4).

Figure 4

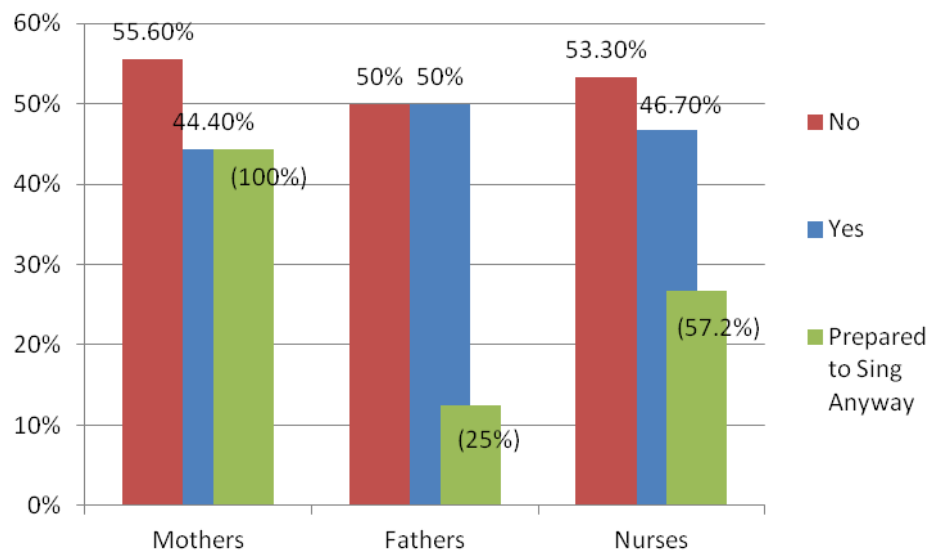
Participants prepared to sing



Feelings of discomfort or embarrassment were expressed by four out of nine mothers (44.4%), four out of eight fathers (50%) and seven out of fifteen nurses (46.7%) at the prospect of singing in the neonatal ward, and of these all four mothers (100%), one out of four fathers (25%) and four out of seven nurses (57.2%) were prepared to sing despite these feelings (see Figure 5).

Figure 5

Feelings of discomfort or embarrassment

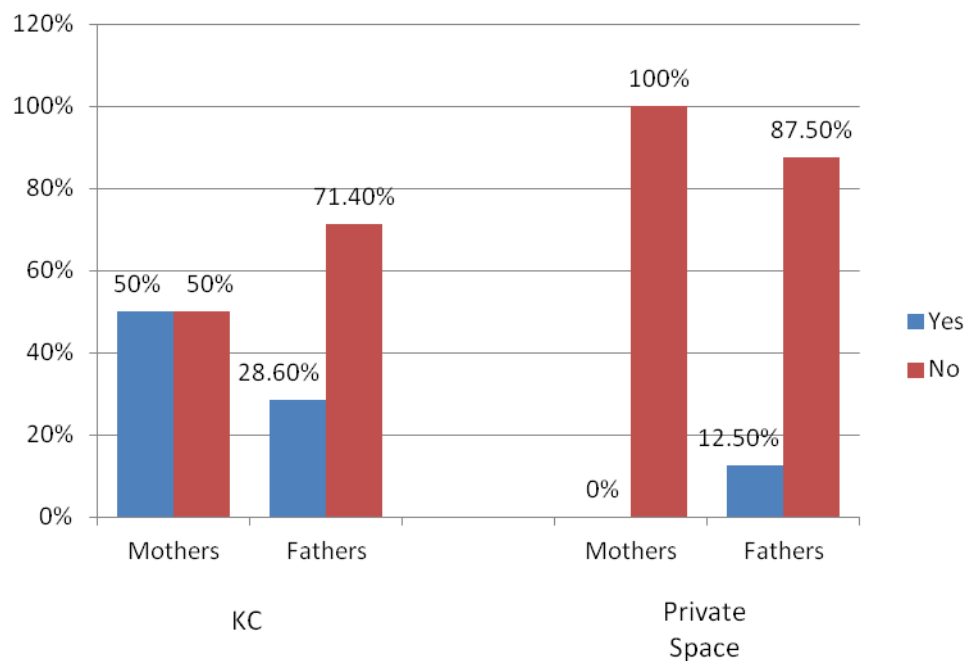


The consummate result from the mothers echoes an observation by Alison Street *et al* (2003, p.628), who throughout their research in the field of maternal infant-directed singing have experienced that ‘a large majority of mothers feel insecure about singing, but that to date, not one mother has stated that she never sings to her infant’.

When asked whether they would feel embarrassed or uncomfortable singing during KC whilst screened from the ward, or in a private space within the neonatal unit, four out of eight mothers (50%) and two out of seven fathers (28.6%) indicated that they would during KC, whilst none of the eight mothers and one out of seven fathers (12.5%) indicated that they would in a private space (see Figure 6).

Figure 6

Feelings of discomfort or embarrassment in KC/private space



This may imply that being visible to strangers accounts for much of the discomfort or embarrassment experienced by fathers, but that being heard by strangers causes mothers more discomfort or embarrassment than it does fathers. All of the mothers and fathers that answered the final question indicated that they would not object to neonatal nurse infant-directed singing as a part of care.

Of the nurse group, seven out of fifteen (46.7%) have sung and/or currently sing to infants on neonatal wards, and nine out of fourteen (64.3%) have experienced music to be beneficial to infants in neonatal care, which is quite considerable given that music is not a standard part of practice. In explanation of how music was experienced to be beneficial, answers indicated both pacification and stimulation in older infants and pacification in premature and unspecified maturity infants as a result of music provided through a mixed range of media, including background radio, musical toys and mobiles, singing and humming.

Two of the explanatory statements observed similar benefits to those found by several research studies, with music helping premature infants to settle more quickly and decreasing the incidence of apnoea and bradycardia, and singing engaging infant attention, helping to calm distressed infants.

Several of the additional comments made by the nurse group showed support for the use of music intervention in neonatal care and offered perceived benefits for infants, parents and staff, with one participant indicating that he/she has encouraged parental infant-directed singing of nursery rhymes. Only two nurses provided an explanation for opposing neonatal nurse infant-directed singing, which was on the grounds that it is over stimulating for premature infants and that provision is more appropriate by parents due to familiarity and bonding factors. The latter points are not disputed by this study; as has been made apparent that music can be over stimulating for infants if not used responsively, especially for premature infants, and the provision of infant-directed singing by parents is most favourable, but does not negate the need for continuity in provision or provision in its absence.

The implications from these results are encouraging, as significantly more than half of the nurses and fathers and all of the mothers would be prepared to sing to infants, with several of the nurses either having sung or currently singing as a part of practice and one having provided infant-directed singing encouragement to parents. This suggests that the incorporation of the intervention proposed by this study into nursing and parental practice may be both practical and viable.

FUTURE RESEARCH

Many of the research studies in the field of music intervention in neonatal care to date have been invalidated or seriously undermined by flaws in their design or application. Common errors include the use of music at higher than recommended sound levels (Krueger, 2010, p.13), use of sample groups of inadequate size and/or not randomly selected (Neal and Lindeke, 2008, p.324), and inexplicit descriptions of several aspects of research, such as data collection methods and variables (Hodges and Wilson, 2010, p.12).

It is currently the premise of research to establish music intervention as unequivocally beneficial to infants in neonatal care, and also to determine the most efficacious methods and means for its provision. There are several areas already highlighted by this study as requiring further research due to a lack of scientific rigor or the absence of research:

- The use of music to promote developmental goals in the ‘intermediate’ stage of neonatal care (see *Sound, music and extrauterine development*, p.23)
- The impact of music on maternal attachment rating when used to support maternal infant-directed singing (see *Music and relationships*, p.28)
- The use of music with hearing impaired infants (see *Gender*, p.35)
- Infant preferences in maternal, paternal, and male/female stranger infant-directed singing (see *Infant preference and infant-directed singing*, p.36)
- The potential benefits of singing in pregnancy (see *Nurse training*, p.55)
- Gender differences in responses to music (see *Gender*, p.35)

- The cross-cultural characteristics of play-songs (see *Culture*, p.33)
- The potential for charitable funding for choral nurse singing (see *Nurse training*, p.55)
- The comparative effectiveness of individual lullabies and play songs (see *Music content*, p.42)
- The use of multimodal stimulation in conjunction with music intervention within nursing practice (see *Nurse training*, p.55)

However, this list is not exhaustive; there are many more areas for future research that have been found lacking, as summarised by Standley (2011) through meta-analysis of the past twenty years of music research in NICU:

- Long term research investigating developmental outcomes for infants receiving NICU-MT
- The differentiated effects of air vs. fluid transmission of sound on the developing auditory system of the extrauterine premature infant and, further to this, how gestational age or gender affects responses to these stimuli
- The effects that positioning and movement have on premature infants during MT
- The use of positioning during MT, especially multimodal NICU-MT and during PAL [Pacifier Activated Lullaby device] protocols, with measures of neurologic and developmental outcomes

- Investigation into the benefits of MT received by infants in NICU post discharge, based upon observation that these infants appear to be calmer than those who have not received NICU-MT (Standley, 2011, pp.11-13)

In addition, there are also several areas for research which would be a necessary prerequisite to the implementation of the proposed music intervention:

- The benefits of live vs. recorded infant-directed singing by parents and neonatal nurses
- The efficacy of neonatal nurse singing, both in addition to and in the absence of parental infant-directed singing
- The efficacy of neonatal nurse singing in encouraging and supporting parental infant-directed singing
- The influence of infant presence and absence on the modification of infant-directed singing by strangers
- The potential for neonatal nurse and parental infant-directed singing to provide the ‘new experiences’ expounded by Shoemark (2006) (see *Infant preference and infant-directed singing*, p.36)
- The potential costs for neonatal nurse infant-directed singing training

Many research studies, whether they have experienced success or failure, have helped to further understanding of the necessary requirements and parameters that research into music intervention with infants in neonatal care needs to adhere to. Several articles and studies have catalogued these into comprehensive summaries or lists of

recommendations for research, which need to be observed in order to produce valid, reliable results.

The study that presents the most comprehensive list of research recommendations is that conducted by Neal and Lindeke (2008, pp.324-5), which supplements a checklist for research evaluation originally authored by Philbin and psychologist Patricia Klaas, designed for use by clinicians using auditory intervention with infants (see Appendix I). This list can be supplemented further by a more recent literary review of research pertaining to responses by premature infants to music. Professors Ashley Hodges and Lynda Wilson (2010) emphasise the importance of specifying the variables that may influence these responses within ‘clear conceptual models’ that should form a basis to all studies. These variables are classed as:

- Infant characteristics: gender, gestational age, morbidity status, behavioral state and hunger level at the time the music is administered, and exposure to other types of stimulation
- Setting characteristics: lighting level, ambient noise level, temperature, number of visitors and staff in the unit when the intervention is provided, and whether the NICU is a ‘developmentally friendly’ environment
- Intervention characteristics: type of music (e.g. live versus recorded, sedating versus stimulating, maternal voice versus other voice), decibel level, whether it is provided contingent on infant cues, as well as the ‘dose’ of the intervention, including frequency, duration, and timing (Hodges and Wilson, 2010, p.13)

Another important aspect to be considered in future research, which has come to light through the research conducted by Arnon *et al* (2006, pp.134-5), is the need to

measure the effects of music in the period following music intervention. Given that benefits were experienced during the thirty minutes following the end of music therapy but could not be monitored for longer, it remains to be determined how long benefits last.

An undergraduate study which presents potentially important findings that require consideration by future research pertains to infant eye movement responses to music intervention and the implications for the initiation of eye contact. Keller *et al* (2008) observed that, by thirty-two weeks of age, premature infants who had been exposed daily to recorded maternal voice opened their eyes in response to the recordings, whereas premature infants without such exposure did not.

DISCUSSION

While music cannot provide a solution to the practical issues of neonatal ward overcapacity, nursing shortages, the increasing incidence of premature birth and harsh ward environments, it can help offset the detrimental effects of these issues through supporting the physiological, psychological and emotional development of infants and the physiological, psychological and emotional well being of parents and carers, attributes which endorse music as an ideal intervention at a time when further neonatal interventions are so desperately needed, both in the UK and worldwide.

Music intervention transcends the physically inhibitive nature of medical equipment, benefitting infant physiological and neurological development through supporting the self-regulation of arousal states and the processing of stimuli, helping to counteract developmental delays and abnormalities, reduce the experience of pain and promote language development. Emotional development is facilitated through the emotive communication of song, extending the womb music continuum by providing the emotional conditioning lost with premature birth, helping to counteract the detrimental impact on emotion and communication and, resultantly, thought, behaviour, growth and intelligence.

Infant-directed singing of lullabies is a specifically endorsed form of cross-cultural music intervention which shares many of the characteristics of play songs. This tonal music, which incorporates the emotive communication inherent in infant-preferred consonance, can be used responsively according to developmental need and requires no previous musical knowledge to perform. Parents' natural inclination to sing these songs at a higher pitch in infant presence reflects infant preference for higher pitch music and facilitates greater emotive communication.

Through the act of live infant-directed singing parents and carers not only develop relationships with the infant and facilitate bonding, but can potentially develop collaborative relationships with each other, experience reduced anxiety and stress and positive emotions, all of which could serve to enhance working practice, the setting as a whole and ultimately be of further benefit to the infant. Minimal nurse training would be required in the form of instruction for use and experiential comfort in singing in order to engage in the practice, and parental training in infant responses could conceivably be engendered through nursing practice of infant-directed singing.

The practice of live infant-directed singing by nurses and parents can be deemed a potentially viable and practical alternative to the equivalent provision by professional music therapists in light of bonding, infection risk and cost related issues. Its practicality and viability within the neonatal care setting and practice is exemplified by the extant incorporation of music intervention practices into medical settings and its delivery by medical professionals.

For the proposed intervention to be integrated into nursing practice, infant-directed singing would need to be considered a standard aspect of care by nurses, just like any other intervention, and such a cultural change could only come about through practise and experience over time. The promising questionnaire findings, while indicating a willing response from many parents and nurses, highlight the lack of comfort many people experience with singing in front of others, rather than singing *per se*. Choral singing for nurses and supported singing for parents could conceivably help to overcome this obstacle in order for them to experience the benefits of singing and for infants to benefit from their singing.

Future research, as furtherance of and in addition to anterior research, is axial to the development and utilisation of nurse and parent infant-directed singing as an intervention for infants in neonatal care, and must be conducted into many aspects of impact, methods of use and types of music intervention. In both design and application the recommendations resulting from past failures and findings need to be considered in order to produce valid results.

CONCLUSION

This study has sought to endorse neonatal nurse and parental live infant-directed singing with the potential to be a practical, viable and beneficial form of music intervention for infants in neonatal care that could be integrated into nursing and parental practice in the neonatal ward setting. This has been achieved by satisfying the three criteria which formed the basis of the initial hypothesis. Firstly, that live infant-directed singing is a uniquely beneficial form of music intervention for infants in neonatal care has been demonstrated through the review of a catalogue of extant research studies, which report many profound benefits such as lowered heart and respiratory rates and facilitated parent-infant bonding; however, further research is still necessary before these benefits can be recognised by medical science. Secondly, both research and tradition have evidenced that this intervention requires no specialist musical training to perform, but it would need to be incorporated into nurse training to ensure an understanding of, and consistency in its practise. Discomfort with singing has been highlighted as an issue both through literary research and findings from an informal questionnaire survey. Finally, the delivery of the proposed intervention by nurses and parents has been shown to be a potentially efficacious alternative to the introduction of additional professionals into the ward for its delivery through literature-based research, which indicates the comparative benefits as an increased potential for adult-infant bonding, decreased infection risk and financial saving.

The medical phenomenon of music has yet to prove itself to modern science; however, it is to be hoped that the persistent striving of medical professionals and academics to provide the necessary research and raise awareness of its potential, will eventually bring the gift of song to all infants in neonatal care.

APPENDIX A: Neonatal care information

Table A1: Levels of Neonatal Care (Bliss, 2011a)

Special care	High dependency care	Intensive care
For babies requiring continuous monitoring of respiration or heart rate; for babies receiving added oxygen, being tube fed, receiving phototherapy or recovering from more specialist care.	For babies receiving nasal continuous positive airway pressure (CPAP) but not fulfilling any of the categories for intensive care; any baby below 1,000 grams who does not fulfil any of the categories for intensive care; babies receiving parenteral nutrition, with apnoea requiring stimulation.	For babies needing respiratory support (ventilation); for babies weighing less than 1,000 grams and/or born at less than 26 weeks' gestation and receiving nasal continuous positive airway pressure (CPAP); for babies with severe respiratory disease or who require major surgery.

Table A2: Units providing neonatal care (Bliss, 2011a)

Unit level	Unit type	Care provision
Level 1	Special Care Baby Units (SCBUs)	Special Care More intensive care for short periods
Level 2	Neonatal Units (NNUs)	Special Care High Dependency Care More intensive care for short periods
Level 3	Neonatal Intensive Care Units (NICUs)	Special Care High Dependency Care Intensive Care Specialist Care e.g. surgery (in some cases)

APPENDIX B: Infant prematurity level

(Bliss, 2011b)

Premature baby	Born before 37 weeks
Moderate Premature	Born between 35 and 37 weeks
Very Premature	Born between 29 and 34 weeks
Extremely Premature	Born before 29 weeks

APPENDIX C: Sleep-activity states

(Nurse, 2009, p.456)

1. Deep sleep	Regular breathing, eyes closed, no spontaneous activity
2. Light sleep	Eyes closed, rapid eye movements (REMs), random movements and startles, irregular breathing, sucking movements
3. Drowsy	Eyes open, dull, heavy eyelids, variable activity, delayed response to stimuli
4. Alert	Bright, seems focused, minimal motor activity
5. Active	Eyes open, considerable motor activity, thrusting movements, briefly fussy
6. Crying	High motor activity

APPENDIX D: General principles of infant stimulation

(Standley, 1991, p.21)

1. The preterm infant's immature nervous system tends to become overloaded and exhausted. Signs of infant **overstimulation** include hiccoughing, increased drowsiness, fussiness, yawning, regurgitation, and eye aversion.
2. The most favourable time for productive social interaction is when the infant is in a **stable state of quiet alertness**.
3. Soothing stimuli include non-nutritive sucking, swaddling, gentle rocking, and soft verbalisations.
4. Continuous, unchanging stimulation pacifies and suppresses infant arousal. The **onset** of stimulation and the **discontinuation** of prolonged stimulation arouse.
5. The more modalities (sound, light, movement, swaddling, temperature) continuously stimulated, the more pacification achieved, and pacification is desirable in order to promote neurological development.

*The references contained in the original article are omitted.

APPENDIX E: Principles of family-centred neonatal care

(Merenstein and Gardner, 2006, p.871)

1. Family-centred neonatal care should be based on open and honest communication between parents and professionals on medical and ethical issues.
2. To work with professionals in making informed treatment choices, parents must have available to them the same facts and information of those facts as the professionals, including medical information presented in meaningful formats, information about uncertainties surrounding treatments, information from parents whose children have been in similar medical situations, and access to the chart and rounds discussions.
3. In medical situations involving very high mortality and morbidity, great suffering, and/or significant medical controversy, fully informed parents should have the right to make decisions about aggressive treatment for their infants.
4. Expectant parents should be offered information about adverse pregnancy outcomes and be given the opportunity to state in advance their treatment preferences if their infant is born extremely prematurely and/or critically ill.
5. Parents and professionals must work together to acknowledge and alleviate the pain of infants in the NICU.
6. Parents and professionals must work together to ensure an appropriate environment for infants in the NICU.
7. Parents and professionals must work together to ensure the safety and efficacy of neonatal treatments.
8. Parents and professionals must work together to develop nursery policies and programmes that promote parenting skills and encourage maximum involvement of families with their hospitalized infants.
9. Parents and professionals must work together to promote meaningful long-term follow-up for all high-risk NICU survivors.
10. Parents and professionals must acknowledge that critically ill newborns can be harmed by over treatment, as well as under treatment, and must insist that laws and treatment policies be based on compassion. Parents and professionals must work together to promote awareness of the needs of NICU survivors with disabilities to ensure adequate support for them and their families. Parents and professionals must work together to decrease disability through universal prenatal care.

APPENDIX F: Repertoire

Songs (Blumenfeld and Eisenfeld, 2006, p.68)

Nursery rhymes

Twinkle, Twinkle Little Star, ABCs, Old MacDonald, This Old Man, Itsy Bitsy Spider, Baa Baa Black Sheep, Row Row Row Your Boat, Humpty Dumpty, Hush Li'l Baby, London Bridge

Children's songs

Wheels on the Bus, Barney Theme Song, Where is Thumbkin, It You're Happy and You Know It, Green Speckled Frogs, Flintstones Theme, Brady Bunch Theme, BINGO, Take Me Out to the Ballgame, Hokey Pokey, Scooby Doo

Classic/popular songs

You Are My Sunshine, Over the Rainbow, Do Re Mi, Rudolph, Frosty the Snowman, Twelve Days of Christmas, Jingle Bells, Sunrise Sunset, My Girl, Up On A Roof, New York, New York, Battle Hymn of the Republic

Contemporary pop

Heartache (Dixie Chicks), Alan Jackson (no title given), Copa Cabana, Friends in Low Places (Garth Brooks), Summer Lovin'

CDs of Lullabies (Schwartz and Ritchie, 2007, pp.13-14)

A Child's Celebration of Lullaby (Music for Little People)

A Child's Gift of Lullabies (Someday Baby)

Dream a Little Dream (Transitions Music)

Lullaby Berceuse (Music for Little People)

Lullaby Magic (BMG/Discovery Music)

Lullaby Magic 2 (BMG/Discovery Music)

MusicBabies (MMB Music)

The Rock-A-Bye Collection (Someday Baby)

APPENDIX G1: Singing questionnaire for neonatal nurses

About this questionnaire...

This questionnaire has been issued by Ruby Barnell BA (Hons) as part of primary inquiries into the reception of potential research to be conducted in partial fulfilment of the requirements for the degree Master of Arts Musicology with the University of Wolverhampton. If you have any queries, please contact Ruby Barnell on 07967785456 or rubybarnell@blueyonder.co.uk

The purpose of this questionnaire is to identify any difficulties that Neonatal Nurses may experience with regard to the implementation of practical research into the benefits of singing to preterm infants within the Neonatal unit of Russells Hall Hospital. This is not a consent form, and no practical research is currently being conducted.

How to complete...

Can be completed by one or both parents. Please tick **yes** or **no** using the relevant boxes.

Question 1

If new research suggested that Neonatal nurse singing to preterm infants is beneficial to their health or wellbeing, would you be prepared to sing on a regular basis as part of your care provision?

- ☐ Yes ☐ No

Question 2

Would singing to babies whilst on the Neonatal ward make you feel uncomfortable or embarrassed?

- ☐ Yes ☐ No

Question 3

Do you currently sing to, or have you ever sung to, infants in your care on a Neonatal ward?

- ☐ Yes ☐ No

If YES please explain why

--

Question 4

Have you ever personally experienced music to be beneficial to any infant(s) in Neonatal care?

☐ Yes

☐ No

If yes please explain how

Please use this space to continue or add any comments

Thank you for taking the time to complete this questionnaire. Your input is extremely valuable to this project.

Participant information sheet



School of Sport, Performing Arts and Leisure
University of Wolverhampton

Primary researcher: Ruby Barnell

Supervising Researcher: Dr. Amanda Bayley

Singing to infants in the Neonatal Care Unit environment project

Objective: The objective of this project is to identify a) any difficulties that parents and Neonatal nurses may experience with regard to the potential implementation of practical research into the benefits of singing to infants within the Neonatal Care Unit of Russells Hall Hospital, and b) any relevant experience on the part of Neonatal nurses of musical intervention in a Neonatal Care Unit environment.

Programme: Existing research suggests that singing to infants in the Neonatal Care Unit environment can be beneficial to their health and wellbeing. Based upon these findings, I intend to conduct further research into this field of study. The results from this project will establish the viability of the proposed research. This project involves you completing a short questionnaire that assesses your opinions. Please complete the questionnaire as honestly as you can. Some people may feel uncomfortable or embarrassed in the act of singing in a public place. This is a natural human reaction, and to help us establish whether this would influence your willingness to participate I would appreciate it if you would share your feelings with us openly. The questionnaire typically takes 1-2 minutes to complete.

Confidentiality: All responses will be strictly confidential and the data will be stored confidentially by the primary researcher and eventually destroyed. All data is collected anonymously, and will remain anonymous. The only people with access to the data will be the primary and supervising researchers.

You are free to withdraw from participating in this research and withdraw use of your data at any time without any negative pressure or consequences.

If you require further information, please contact: Ruby Barnell (University of Wolverhampton) **Telephone: 01562 636426 (9am-5pm), or email** [rubybarnell@blueyonder.co.uk](mailto:rubbybarnell@blueyonder.co.uk)

APPENDIX G2: Singing questionnaire for parents

About this questionnaire...

This questionnaire has been issued by Ruby Barnell BA (Hons) as part of primary inquiries into the reception of potential research to be conducted in partial fulfilment of the requirements for the degree Master of Arts Musicology with the University of Wolverhampton. If you have any queries, please contact Ruby Barnell on 07967785456 or rubybarnell@blueyonder.co.uk

The purpose of this questionnaire is to identify any difficulties that parents may experience with regard to the implementation of practical research into the benefits of singing to preterm infants within the Neonatal unit of Russells Hall Hospital. This is not a consent form, and no practical research is currently being conducted.

How to complete...

Can be completed by one or both parents. Please tick **yes** or **no** using the relevant boxes.

Question 1

If new research suggested that maternal/ paternal singing to preterm infants is beneficial to their health or wellbeing, would you be prepared to sing to your baby while he/ she is on the ward, as part of their programme of care?

Mother:

☐ Yes

☐ No

Father/ partner:

☐ Yes

☐

Question 2

Would singing to your baby whilst in the Neonatal ward make you feel uncomfortable or embarrassed?

Mother:

☐ Yes

☐ No

Father/ partner:

☐ Yes

☐

No

If YES to Question 2...

- a) Would you also feel uncomfortable or embarrassed singing to your baby as part of 'Kangaroo Care', whilst screened from the ward?

Mother:

☐ Yes

☐ No

Father/ partner:

☐ Yes

☐

No

- b) Would you also feel awkward in singing to your baby if you were in a private space within the Neonatal unit?

Mother:

☐ Yes

☐ No

Father/ partner:

☐ Yes

☐

No

Question 3

Would you object to nurses singing to your baby as part of their care?

Mother:

☐ Yes

☐ No

Father/ partner:

☐ Yes

☐

No

Thank you for taking the time to complete this questionnaire. Your input is extremely valuable to this project.

APPENDIX H: Questionnaire results

Nurses

Questionnaire no.	Question 1		Question 2		Question 3		Question 4	
	Y	N	Y	N	Y	N	Y	N
1	✓			✓	✓			
2	✓			✓	✓		✓	
3	✓			✓	✓		✓	
4	✓			✓	✓		✓	
5	✓			✓	✓		✓	
6	✓		✓		✓		✓	
7		✓		✓		✓	✓	
8	✓		✓			✓	✓	
9	✓			✓	✓		✓	
10		✓	✓			✓		✓
11		✓	✓			✓		✓
12	✓		✓			✓		✓
13	✓		✓			✓		✓
14	✓			✓		✓		✓
15		✓	✓			✓	✓	
Total	11	4	7	8	7	8	9	5

Nurses - Question 4

Questionnaire no.	Mature		Premature		NS		Type of Music			
	Stim	Pac	Stim	Pac	Stim	Pac	Rec/bg	Toys	Sing/hum	NS
1										
2				✓						✓
3	✓	✓								✓
4						✓			✓	
5		✓								
6						✓		✓		
7		✓								✓
8	✓	✓						✓		
9						✓				✓
10										
11										
12										
13										
14										
15		✓		✓(rec bg)			✓	✓		
Total	2	5	0	2	0	3	1	3	1	4

Parents - Mothers

	Question 1		Question 2		Question 2a		Question 2b		Question 3	
Questionnaire no.	Y	N	Y	N	Y	N	Y	N	Y	N
1	✓		✓			✓		✓		✓
2	✓		✓		✓			✓		✓
3	✓		✓		✓			✓		✓
4	✓			✓		✓		✓		✓
5	✓			✓	✓			✓		✓
6	✓			✓						✓
7	✓			✓		✓		✓		
8	✓		✓		✓			✓		✓
9	✓			✓		✓		✓		✓
Total	9	0	4	5	4	4	0	8	0	8

Parents - Fathers

	Question 1		Question 2		Question 2a		Question 2b		Question 3	
Questionnaire no.	Y	N	Y	N	Y	N	Y	N	Y	N
1	✓		✓			✓		✓		✓
2	✓			✓		✓		✓		✓
3		✓	✓		✓		✓			✓
4										
5	✓			✓			✓		✓	
6		✓	✓		✓			✓		✓
7	✓			✓		✓		✓		
8	✓			✓		✓		✓		✓
9		✓	✓			✓		✓		✓
Total	5	3	4	4	2	5	1	7	0	7

Key

 = question not answered

NS = not specified

Stim. = stimulating

Pac. = pacifying

Rec bg = recorded background

APPENDIX I: Research checklist

(Neal and Lindeke, 2008, pp.324-5)

1. The purpose of the study is clearly stated, intervention and outcome variables logically follow from the purpose, and no commercial interests influence the research.
2. The experimental design is thoroughly described, the data collection is planned before initiation of the study, and the rationale for subject selection is clear, makes sense, and is related to the outcome measures.
3. Sample size is determined by power analysis, and the conditions are controlled.
4. Subjects reflect the population of interest, demographics are described (age at birth and testing, race, sex, medical history, and so on), and group inclusion and exclusion criteria are clearly stated.
5. The method of subject selection is reported, and subjects are randomly assigned to groups and stratified into homogeneous subgroups.
6. Group assignments are randomized and clearly described.
7. Procedures for intervention administration are clearly described and carried out: Informed consent is obtained, sound level measurements include a weighting scale and meter response times, intervention conditions and procedures are clearly described and controlled, infant condition is controlled; investigators are reliable in the method of determining state, and rationales for modifying or discontinuing the intervention are clear.
8. Investigators, caregivers, data collectors, and analyzers are blinded or masked, or there is a placebo condition along with a nontreatment control condition.
9. There are predefined conditions for removing subjects from the study, subject attrition is described, and the effect of losses is analyzed.
10. All relevant information about subject responses to the intervention is reported; undesirable responses and long-term consequences are evaluated; measurements are standardized, consistently applied, and logically related to the study purpose and intervention; and relevant intervention costs are described.
11. Presentation and analysis of data are clear, discrepancies between planned and actual numbers of subjects are explained, descriptive measures are identified for all important variables, appropriate statistical tests are employed, results are interpreted accurately, and important hazards and limitations are assessed.

12. Recommendations for practice are clear and consistent with results, negative findings or failures to obtain results are reported, and reservations about the use of the intervention are stated.

GLOSSARY

(Definitions adapted from: Nurse, 2009; *Oxford Dictionary of English*, 2006)

Analgesic: pharmacological agent that relieves pain without causing unconsciousness.

Apnoea: temporary cessation of breathing

Bradycardia: abnormally slow heart action.

Cardiac: relating to the heart.

Congenital abnormality: a physical abnormality present from birth.

Endorphin: any of the group of hormones secreted within the brain and nervous system and having a number of physiological functions. They are peptides which activate the body's opiate receptors, causing an analgesic effect.

Entrain: (of a rhythm or something which varies rhythmically) cause (another) gradually to fall into synchronism with it.

Extrauterine: existing, formed, or occurring outside the uterus.

Ex utero: outside a woman's uterus; after birth.

Gestation: the process or period of developing inside the womb between conception and birth.

Gustatory-olfactory stimulation: stimulation of the senses of taste and smell.

Homeostasis: the tendency towards a relatively stable equilibrium between interdependent elements, especially as maintained by physiological processes.

Hyperalerting responses: abnormally or extremely alert in response to stimuli.

Hypoxia: reduced oxygen availability to tissues or foetus.

Intrauterine: within the uterus

Intraventricular haemorrhage: bleeding in or around the ventricles of the brain.

Intestinal peristalsis: the involuntary constriction and relaxation of the muscles of the intestine, creating wave-like movements which push the contents of the canal forward.

In utero: in a woman's uterus; before birth.

Kangaroo care (KC): a method of caring for a premature baby in which the infant is held in skin-to-skin contact with a parent, typically the mother, for as long as possible each day.

Kinaesthesia: awareness of the position and movement of the parts of the body by means of sensory organs (proprioceptors) in the muscles and joints.

Nasogastric tubes: tubes supplying the stomach via nose.

Neonate: an infant between birth and the 28th day.

Neurodevelopmental: the development of the neurological system.

Neurological: concerning the anatomy, functions, and organic disorders of nerves and the nervous system.

Oxygen saturation (blood): the percentage of oxygen in the blood.

Papillary: a small rounded protuberance on a part or organ of the body.

Parenteral: administered or occurring elsewhere in the body than the mouth and alimentary canal.

Perinatology: the branch of obstetrics that dealing with the period around childbirth.

Reflexive startle: a loud noise such as a hand clap elicits neonatal arm abduction and elbow flexion and the baby's hands stay clenched

Respiratory: relating to or affecting respiration (breathing) or the organs of respiration.

Respiratory distress syndrome: a leading cause of morbidity in neonates. The lungs lack surfactant which prevents alveolar collapse at the end of respiration.

Sensorineural damage: damage to the inner ear or the auditory nerve.

Surfactant: substance which tends to reduce the surface tension of a liquid in which it is dissolved.

Systolic: the phase of the heartbeat when the heart muscle contracts and pumps blood from the chambers into the arteries.

Thermoregulation: the regulation of temperature, especially one's own body temperature.

Trimester: a period of three months, especially as a division of the duration of pregnancy.

Vestibular stimulation: stimulation of the sense of balance.

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